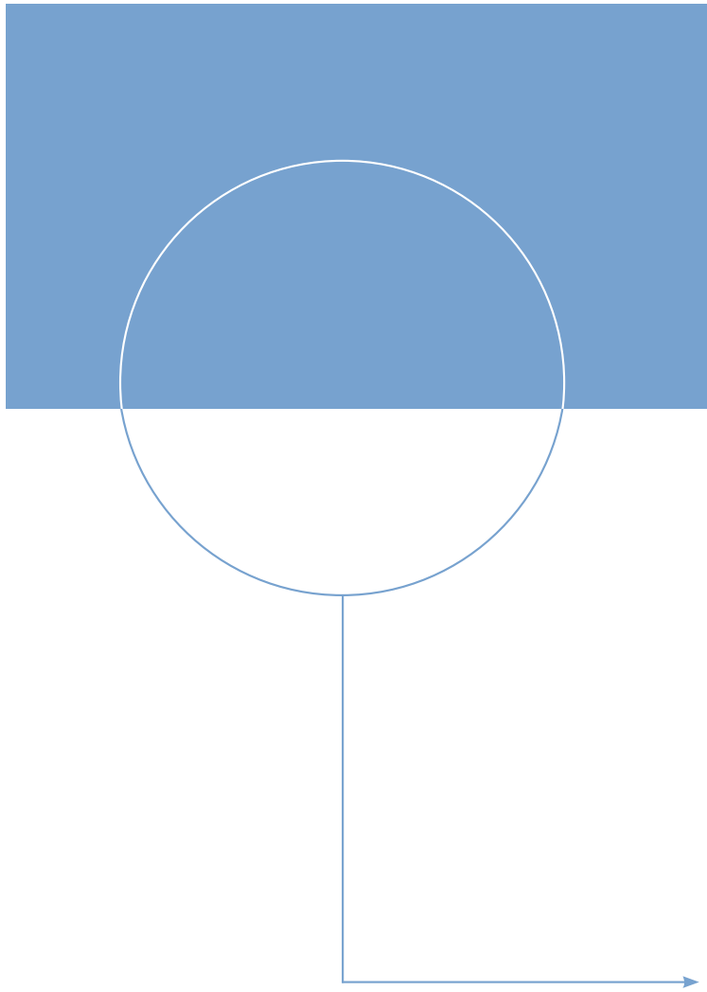

Master's thesis

2019

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Developing a framework for a performance measurement system for patient flow at outpatient clinics

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Developing a framework for a performance measurement system for patient flow at outpatient clinics

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Engineering and ICT
Submission date: June 2019
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Preface

This master thesis concludes a five-year Master of Science degree in Engineering and ICT - Production Management at the Department of Mechanical and Industrial Engineering at the Norwegian University of Science and Technology, NTNU, in Trondheim.

I want to thank my supervisor Marco Semini, and my co-supervisor Aili Bertnum at NTNU for unfailing support, guidance, and feedback through this process.

I want to thank Oslo University Hospital and Marianne Hægh Martinussen for collaborating with me on this thesis. A special thanks to the lovely people of the Division of Head, Neck, and Reconstructive Surgery for giving of their time and letting me pick their brains on patient flow performance measurement.

Finally, to my fellow students and friends, thank you for your support, your advice, and for following along on this five-year journey. To my family, I would not have been here without you. Thank you for everything you have given me and for all the love and support you keep giving me every day.

Trondheim 11.06.2019

Hanna Olufine Holte Wingaard

Executive summary

The last decades have seen an increase in demand for outpatient services. An unprecedented surge in population growth, longevity, and urbanization have led to increasing demand for health care services, and a policy of switching from inpatient services to outpatient services has put the pressure on the outpatient clinics. A critical way of boosting hospital performance is by improving patient flow. However, literature concerning performance measurement systems for patient flow and performance measurement of outpatient patient flow is scarce.

The purpose of this master thesis is to develop a framework for performance measurement of outpatient clinic patient flow. To do this, two research objectives have been identified.

RO1 Identify the performance indicators used to measure patient flow performance at outpatient clinics.

RO2 Develop a framework for performance measurement of outpatient clinic patient flow.

First preliminary research was used to establish an overview of the field of performance measurement and hospital patient flow. The preliminary research was used as a basis for the literature study, and to find the most recognized theory on performance measurement.

From the performance measurement theory, a structure for the case study was developed. This structure, in collaboration with the overview of performance measurement of patient flow from the literature study, lay the foundation for the interview guide of the case study.

The result of the literature study and the case study was discussed and analyzed using the performance measurement theory to fulfill the research objectives.

The resulting list of performance indicators for patient flow consisted of 11 indicators across both clinical and operational patient flow. Four of the performance indicators were collected from the case study, while the remaining seven came from the literature study. The developed framework built on this list alongside performance measurement system theory, and the results from the case study. The final framework uses the Donabedian framework for health care measures to divide the performance indicators into process, structure, and outcome indicators. It also gives the managerial users of the indicators, divided into unit leaders, department leaders, and division leaders. The framework can be used when designing performance measurement systems for outpatient clinics.

Sammendrag

De siste tiårene har sett en økt etterspørsel etter polikliniske tjenester. En hittil enestående økning i befolkningsvekst, levetid og urbanisering har økt etterspørselen for helsetjenester, og en trend for å bytte fra behandlinger som tidligere krevde innleggelse på sykehus til polikliniske behandlinger, har satt press på poliklinikkene. En essensiell måte å øke prestasjonen til sykehusene på er ved å forbedre pasientflyten. Men, det er lite litteratur på prestasjonsmålesystemer for pasientflyt og prestasjonsmåling av poliklinisk flyt.

Hensikten med denne masteroppgaven er å utvikle et rammeverk for prestasjonsmåling av pasient flyt i poliklinikk. For å gjøre dette har to forskningsmål blitt identifisert.

Forskningsmål 1 Identifisere prestasjonsmåleindikatorene som kan brukes til å måle pasientflyten på poliklinikker

Forskningsmål 2 Utvikle et rammeverk for prestasjonsmåling av pasientflyt på poliklinikker.

Først ble et forberedende søk gjort for å etablere en oversikt over prestasjonsmåling og pasientflyt på sykehus. Det forberedende søket ble brukt som et grunnlag for litteraturstudien, og for å finne den mest anerkjente teorien om prestasjonsmåling.

Fra prestasjonsmålings teorien ble en struktur for case-studien utviklet. Denne strukturen, i samarbeid med en oversikt over prestasjonsmåling av pasientflyt fra litteraturstudien, dannet grunnlaget for intervjuguden brukt i case-studien.

Resultatet av litteraturstudien og case-studien ble diskutert og analysert ved å bruke prestasjonsmålings teorien for å oppfylle forskningsmålene.

Rammeverket som ble utviklet bygger på listen over mulige prestasjonsindikatorer for pasientflyt, prestasjonsmålesystem teori og resultatet fra case-studien.

Den endelige listen med prestasjonsmåleindikatorer for pasientflyt bestod av 11 indikatorer for både klinisk pasientflyt og operasjonell pasientflyt. Fire av prestasjonsmåleindikatorer var hentet fra case-studien, mens de gjenværende syv ble hentet fra litteraturstudien. Det utviklede rammeverket bygget på denne listen, vedsiden av prestasjonsmålessystem teori og resultatet fra case-studien. The endelige rammeverket bruker det Donabediske rammeverket for prestasjonsmåling i helsevesenet, for å dele prestasjonsmåleindikatorene inn i prosess-, struktur- og resultat-indikatorer. Det gir også hvilke ledelsesgrupper som kan ha nytte av indikatorene, fordelt inn i enhetsledere, avdelingsledere og klinikkledere. Rammeverket kan brukes ved utforming av prestasjonsmålesystemer for pasientflyt på poliklinikker.

Contents

List of Figures

List of Tables

List of Abbreviations

A list of the abbreviations used in this thesis.

AC Access block

BT Boarding time

C Cancellations

CI cochlear implant

DA Discharge and admittance

DTE Door to event time

IO1 Interview object 1

IO2 Interview object 2

IO3 Interview object 3

IO4 Interview object 4

KPI Key performance indicator

LOS Length of stay

LWBS Left without being seen

O Occupancy

OUS Oslo University Hospital

PI Performance indicator

PMS Performance measurement system

R Readmission

RHA Regional Health Authority

RO1 Research objective 1

RO2 Research objective 2

ROU Room utilization

RU Resource utilization

ST Service time

T Throughput

TS Treatment status

WT Wait list

WTB Wait time before the hospital

WTH Wait time at the hospital

WQ Wait queue

Terminology

This chapter shortly explains the different health care terms that are used in the thesis. The terminology is divided into two lists, one for common terms, and one for the terms for the thesis. The terms in the latter list were created for this thesis, and may not be common terms or their definition may be based on the thesis' context. Both lists are meant to give an overview of the different terms used in the thesis, as well as to give quick access to words that may be unknown to the reader.

List of Common Terms

Audiologist a medical professional offering therapy for individuals with impaired hearing.

Audiology therapy of individuals having hearing impairment.

Cochlear implant an electronic prosthetic device that enables individuals with sensorineural hearing loss to recognize sounds and consists of an external microphone and speech processor, and electrodes implanted in the cochlea.

Epicrisis a critical or analytical summing up of a medical case history.

Inpatient a hospital patient who receives lodging and food as well as treatment.

Outpatient a patient who is not hospitalized overnight but who visits a hospital, clinic, or associated facility for diagnosis or treatment.

Patient's charge The amount the patients have to pay for an appointment at the hospital. The Norwegian government pays for most of the appointment, but the patients have to pay a small amount themselves.

Somatic Relating to, or affecting the body. The somatic part of the hospital treats physical illness in the body.

Speech and language therapist therapy of individuals having hearing impairment.

List of Terms for the Thesis

Discipline A field within medicine.

DIPS-system The resource control tool of OUS. It is the system where patients are registered with their appointments. It contains both patient information and appointment information such as which doctor had the appointment and the appointment's duration.

LIS-system The management tool of OUS, where reports and analyses, waiting lists, finances, project information and other management information is made available.

Outpatient services The medical services offered by outpatient clinics.

Outpatient clinic The physical area dedicated to offering outpatient services.

Patient flow The movement of a patient from one step in the care process to the next.

Patient group Patients having the same diagnosis or undergoing the same treatment.

Patient journey The specific treatment steps for a defined patient group.

Introduction

This chapter gives the motivation and problem description in the background for this thesis. It defines the research objective, the research questions, and the research scope. In addition, it presents the outline of the thesis.

Throughout this thesis, abbreviations and health care terminology are used. Their explanation can be found in the Chapters "List of abbreviations" and "Terminology"

1.1 Background and problem description

The last decades have seen an unprecedented increase in population growth, longevity, and urbanization (OECD, 2017). The increase in urbanization has led to more accessible health care but combined with the population growth; it has caused increased pressure on already highly demanded health care services (OECD, 2017). Furthermore, with old age comes a rise in chronic illnesses along with more complex illnesses and treatments, which also puts pressure on health care services.

One of the principles of health care, recommended by the Organization for Economic Co-operation and Development, is to replace relatively expensive inpatient treatments with less costly outpatient treatment. The policy aims to cut cost and increase the quality for the patient by delivering the services as close to the patient as possible (Ringard et al., 2013). The policy cuts expensive inpatient stays, while also making it easier for the patient to receive quick and non-intrusive care, often at hospitals closer to their own homes. In Norway, the policy has been in effect since the late 1980s (Ringard et al., 2013) and has produced a surge in demand for outpatient services. From 2012 to 2018, the number of outpatient consultations increased by approximately 23.5%, and in 2018, approximately 83.5% of patients being treated

at Norwegian hospitals used the outpatient services (Statistics Norway). The numbers can be seen in the table in Appendix A.

According to the Norwegian Directorate of Health's national health care objectives, the health services should have good quality, be safe, available, effective and efficient, and with shortest possible wait times (The Norwegian Directorate of Health, 2015). In order to accomplish this, while also proceeding with the policy of switching to outpatient services, Norwegian hospitals need to continue improving their outpatient performance as a response cannot only lie in an expansion of resources. A critical way of boosting hospital performance is by improving the patient flow (Litvak, 2009) (Villa et al., 2014), due to flow performance being an essential aspect of organizational performance (Schmenner, 2001).

Looking at the patient flow allows for seeing bottlenecks and for putting hospital patient data into context. It is pointed out in Kros and Brown (2013), that quality of service and quality control and improvement is more critical for health care services than most other service industries. This is because the poor quality in health care might lead to further illness and reduced quality of life and in the worst case, to unnecessary fatalities. Improving patient flow can lead to a more efficient, effective, and high-quality health care service. A smooth flow of patients should lead to a more effective use of resources, freeing up bottlenecks, and increasing resource utilization.

To be able to efficiently manage and improve the patient flow performance, using a performance measurement system to monitor the performance is recommended by Andersen and Fagerhaug (2002) and Neely et al. (1995). Performance measurement can be a foundation for, amongst others, implementing strategies and policies, trend monitoring, improvement prioritization, and improvement project evaluation. It can also be a basis for benchmarking and increase motivation (Andersen and Fagerhaug, 2002).

Performance measurement in operations has been receiving a lot of attention since the 1980s (Choong, 2014), but the health care sector seems to be lagging. There exists a research gap for performance measurement of patient flow at hospitals. Though many researchers use indicators of patient flow when looking at clinic performance, there are few overarching performance measurement systems - moreover, none looking at outpatient clinics.

This master thesis hopes to start filling this research gap by developing a framework for a patient flow performance measurement system.

1.2 Research objectives

This thesis identifies two research objectives. Research objective 1, RO1, to establish an As-Is view of performance measurement of patient flow, and research objective 2, RO2, to develop a framework for performance measurement systems.

RO1 Identify the performance indicators used to measure patient flow performance at outpatient clinics.

RO2 Develop a framework for performance measurement of outpatient clinic patient flow.

RO1 will be answered by looking at the existing literature of research using patient flow performance, and by a case study at a Norwegian hospital to see how performance measurement is done there.

RO2 will be answered by the existing literature of research using patient flow performance measurement systems and by a case study at a Norwegian hospital to see what their performance measurement experience is. This will be analyzed in light of performance measurement theory to develop a framework.

1.3 Scope

This section outlines justification to the reductions in scope made by this thesis definition of patient flow, the hospital, the outpatient clinic, and the performance measurement system.

Patient flow

Patient flow can be described from two different perspectives: clinical flow and operational flow Côté (2000). The clinical flow can be defined as the patient's progression through its patient journey. It is the flow that shows the progression in the patient's health status Côté (2000). See Figure 1.3.1. It starts when the patient gets ill and finishes when the patient is healthy again. For patients with chronic illnesses, this journey will have no end and be a constant journey of consultations and treatment. The second definition is for operational patient flow. It is defined as the movement of patients through a set of locations in a health care facility Côté (2000). See Figure 1.3.2 Therefore, in line with the definition of flow by (Hopp and Spearman, 2001), patient flow performance can be defined as the speed at

which patients are transferred from one step in the care process to the next. This thesis will look at how patient flow performance can be measured with a performance measurement system.

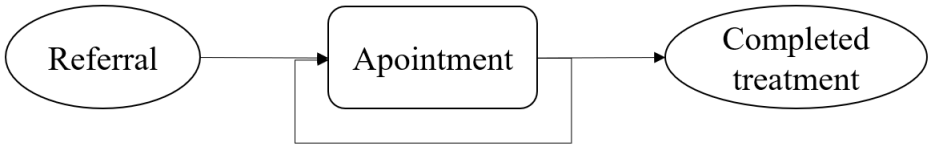

Figure 1.3.1: The patient flow through the patient journey

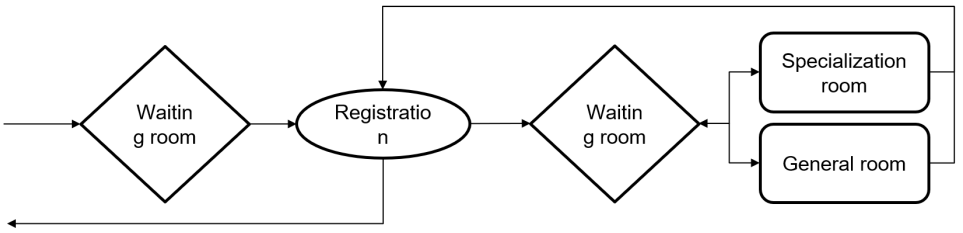

Figure 1.3.2: The at hospital patient flow

The hospital

This thesis views the hospital as a four-part subsystem consisting of the outpatient clinics, the surgery wards, the emergency department, and the inpatient wards. This view is represented in Figure 1.3.3. The thesis only looks at the patient flow performance of the outpatient clinics' patient flow and excludes all non-somatic services, i.e., services related to mental health.

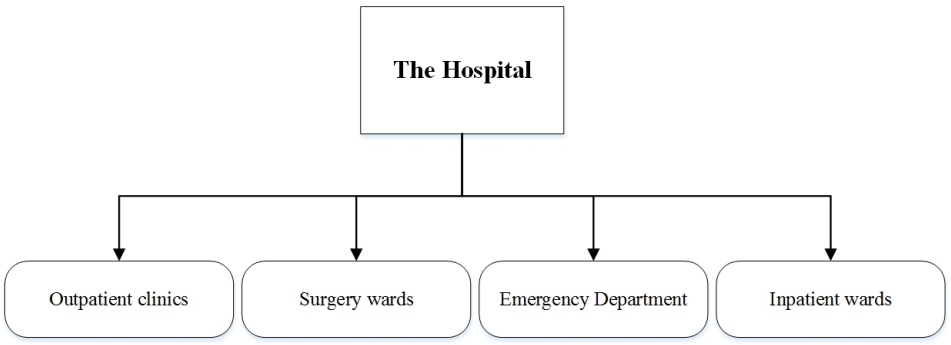

Figure 1.3.3: The four subsystems of a hospital

Outpatient care

Health care at hospitals has traditionally been differentiated between inpatient and outpatient care. Inpatient care is provided when patients are required to stay in the hospital for the duration of their treatment or illness, while outpatient care patients are treated and released the same day Côté (2000). SINTEF (2005) distinguishes between four levels of hospital treatments:

- Inpatient treatment - Hospital stays with one or multiple overnight stays.
- Inpatient day treatment - Hospital stays without an overnight stay, treatment over one or multiple days.
- Outpatient day treatment - Outpatient consultations for day medicine or day surgery. No overnight stay.
- Other outpatient consultations - Controls, examinations, and simple treatments. No overnight stay.

The two latter are performed at outpatient clinics. Since the thesis focuses on the outpatient clinic subsystem, measures related to the day surgery outpatient treatments will be excluded. The thesis will only look at measures for the consultations related to the surgery, and not look at the surgical measures.

Receiving outpatient care may be called treatment, examination, appointment, or consultation interchangeably (SINTEF, 2005).

The performance measurement system

Due to time constraints, this thesis will neither test nor implement the framework. All design criteria related to these steps will, therefore, bee excluded.

Due to time constraints, the focus of this thesis will not be to find detailed performance measures, but broader performance indicators as defined in Chapter 3. This will also help ensure generality in the framework.

1.4 Structure

This thesis is constructed of eight chapters. It starts with the introduction that lays the foundation for the thesis, before presenting how it will be

accomplished in chapter two. The theory of the thesis and the result of the literature study is presented in chapter three and four, while the case study result is given in chapter five. Chapter six gives the discussion and result of RO1, while chapter seven gives the discussion and result of RO2. Chapter eight presents the conclusion of the study, along with the limitations and further research. A more detailed description follows below.

Chapter one is the introduction chapter. In this chapter, the background and motivation for the thesis are discussed. The problem description is introduced, and the research objectives are described. Then the scope of the thesis is given before the chapter closes with the thesis structure.

Chapter two is the methodology chapter. In this chapter, the research design and research methods are described. First, it shows the research development and the structure for each research objective. Then a description of each research method approach is given.

Chapter three is the theory chapter. In this chapter, leading theory on performance measurement and performance measurement system design is presented.

Chapter four is the literature chapter. In this chapter, existing literature on patient flow performance measurement is examined. The first section looks at what patient flow performance measurement systems are used in hospitals, while the second studies patient flow performance at outpatient clinics patient.

Chapter five is the case study chapter. In this chapter, the introduction and description of the case study are given, followed by the case study results divided into the topics of interest.

Chapter six answers research objective 1. In this chapter, indicators from existing literature are discussed to ensure they fit an outpatient performance measurement system. First the performance indicators from the case study are presented. Then performance indicators from the literature study are presented and discussed in relation to the case study. Lastly, the set of PIs are given

Chapter seven answers research objective 2. In this Chapter the performance measurement framework is developed. First the preferred set of PIs are evaluated using frameworks and criteria from performance measurement theory. Then the different PMS frameworks are discussed to chose the basis of the new framework. Lastly, the framework is discussed and presented.

Chapter eight is the conclusion chapter. In this chapter, the conclusion

of the thesis is given along with further research on the topic and the thesis limitations.

Methodology

This chapter presents the methodology of this thesis. First, the research design explains the research development and how the methods are applied to fulfill the research objectives. Then the research methods are presented, and the research approach is described.

2.1 Research design

The research development of the thesis is shown in Figure 2.1.1. First preliminary research was used to establish an overview of the field of performance measurement and hospital patient flow. The preliminary research was used as a basis for the literature study, and to find the most recognized theory on performance measurement.

From the performance measurement theory, a structure for the case study was developed. This structure, in collaboration with the overview of performance measurement of patient flow from the literature study, lay the foundation for the interview guide of the case study.

The result of the literature study and the case study was discussed and analyzed using the performance measurement theory to fulfill the research objectives.

The research design for fulfilling RO1 can be seen in Figure 2.1.2. Research objective 1 is to make a list of the performance indicators for outpatient patient flow. To make this list, both the result from the literature study and the case study is used. It looks at the PIs found in the literature study for both the patient flow at the hospital in general, and the patient flow at the outpatient clinics, Chapter 4.3.1. It also considers the performance indicators found in the case study, both from the current system and the

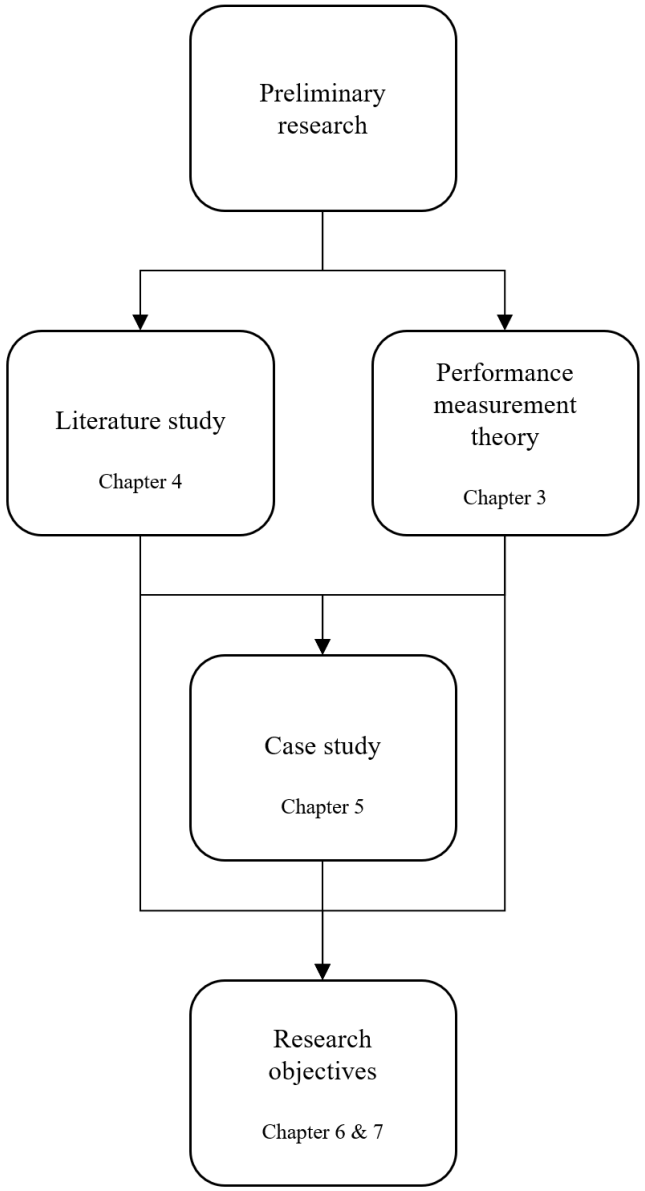

Figure 2.1.1: Research development of master thesis

ideal indicators, Chapter 5.2.2 and Chapter 5.2.3. These lists are discussed and combined in Chapter 6. The final list is also presented in Chapter 6.

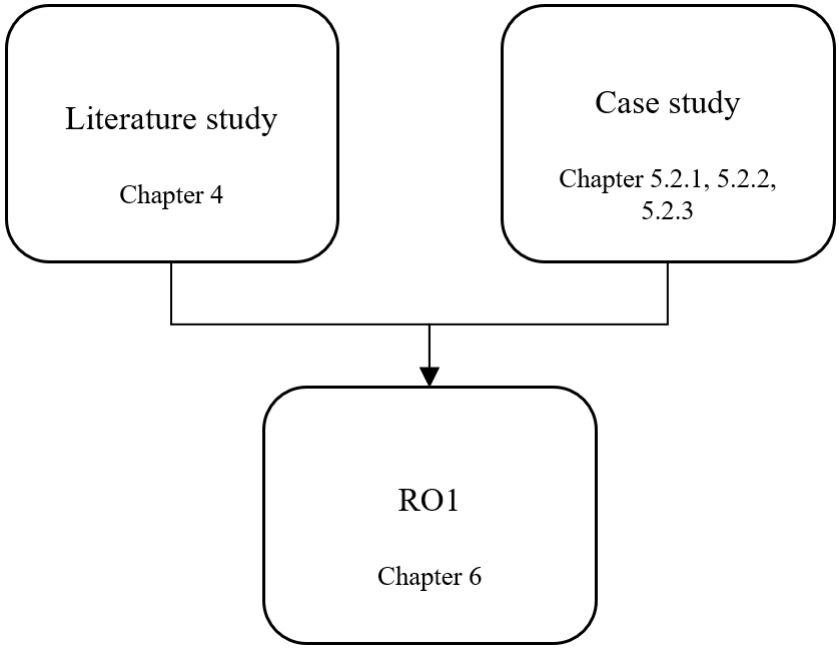

Figure 2.1.2: Research design for RO1

The research design for fulfilling RO2 can be seen in Figure 2.1.3. Research objective 2 is to develop a framework for a performance measurement system for outpatient patient flow. To do this, the result from the literature study and the case study is used. In Chapter 7 the performance measurement systems from literature, Chapter 4.3.2, and the empirical performance measurement system from the case study, Chapter 5.2, is compared with the performance measurement system designed theory in Chapter 3.3. The list of performance indicators from RO1, Chapter 6, is analyzed using performance measurement theory from Chapter 3.3 to choose the appropriate KPIs for the system. The final framework is presented in Chapter 7.

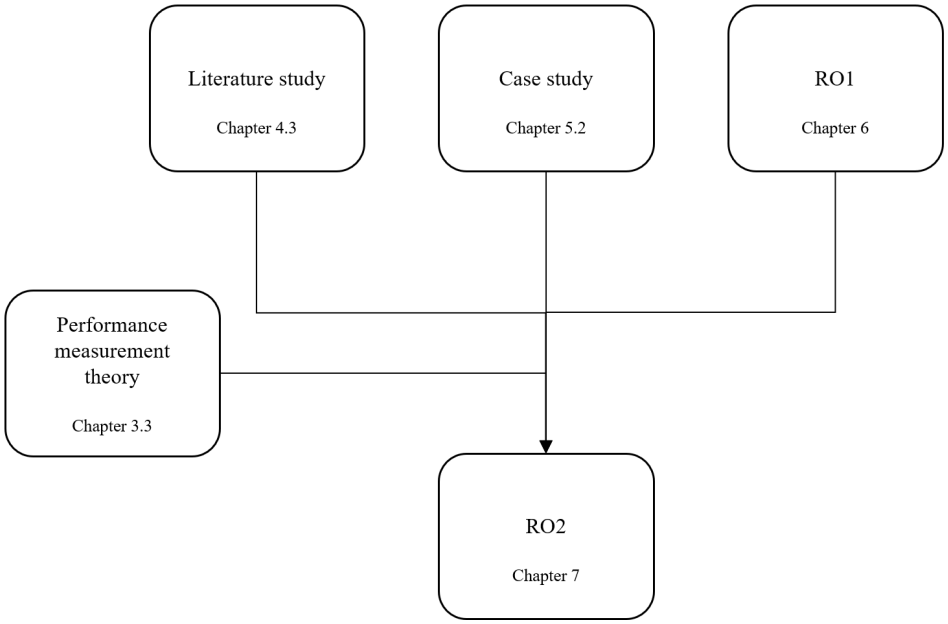

Figure 2.1.3: Research design for RO2

2.2 Research methods

The research methodology is the general approach the researcher takes in order to carry out the research project (Leedy and Ormrod, 2015). The techniques used to collect data and information are referred to as research methods (Karlsson, 2009). There are two main research method approaches, qualitative and quantitative. A quantitative approach uses mathematical and statistical tools to manage the analysis of numerical data, while a qualitative approach is concerned with constructivism, interpretation, and perception (Karlsson, 2009). This thesis uses a qualitative research approach in both the literature study and a case study.

2.2.1 Literature study

The purpose of the literature study is to examine existing literature for research on patient flow performance measurement to establish authority and legitimacy of the research, and to ensure the research-ability of the topic Karlsson (2009).

Preliminary searches showed that the amount of available research on patient flow performance at outpatient clinics was significantly lower than the

amount on the hospital in general. Due to this, the literature study is divided into two separate lines of inquiry. The first line looked at how patient flow is measured at outpatient clinics. This search examined both at the articles that use performance indicators for patient flow and the patient flow performance system. The second line looked at the entire hospital, independent of the subsystem. This search looked at articles that offered discussions on patient flow performance or a performance measurement system.

The approach used was a structured literature search. The structured study differs from a more traditional study in that it involves an explicit description of what types of studies are to be included to limit selection bias on behalf of the reviewer, assess the study quality, and bases the conclusion on those studies which are most methodologically sound (Armitage and Keeble-Allen, 2008).

For the structured literature search, search strings were used for searching databases to provide the initial article collection. Then the results were refined by using filtering tools provided by the search engines for including and excluding on article type, language, and topic categories. The next step was to remove the duplicated articles that were mentioned in both search engines so that a collection of articles was ready for screening. The first round of screening used the basic criteria chosen to provide an objective selection of articles. If there were uncertainty for the relevance of the article, the articles would be included in the next screening.

For the advanced criteria screening the criteria was split into two sets. The first set was aimed at finding articles using performance measurement indicator for measuring outpatient patient flow performance. Moreover, the second set, for articles with a performance measurement system for hospital patient flow.

Database search

The preliminary search was done to achieve a fundamental understanding of patient flow at hospitals, to decide on what search engines would be the best fit for the field, and to construct the search strings for the structured study. The search engines used were *Scopus*, *Web of Science*, *Google scholar*, and *Oria*. Both *Oria* and *Google scholar* returned unnecessarily many results with a high degree of irrelevance. *Scopus* and *Web of Science* were therefore chosen as the thesis search engines.

The search strings that were the result of the preliminary search were used to provide the initial article collection. Table 2.2.1 shows the search strings

used for the different databases. Three different search word sets were used, one for words in connection to KPIs and performance; one for patient flow related search terms, and one for hospital-related terms. Since the hospital was the only part of interest in the health care system, no other words were used in that term set.

Table 2.2.1: Search strings used in the different databases

Search engine	**Search string**
Scopus	TITLE-ABS-KEY (KPI OR "key performance indicator*" OR productiv* OR performance*) AND TITLE-ABS-KEY ("patient flow*" OR "patient pathway*" OR "care pathway*") AND TITLE-ABS-KEY (hospital*)
Web of science	TOPIC: (KPI OR "key performance indicator*" OR productiv* OR performance*) AND TOPIC: ("patient flow*" OR "care pathway*" OR "patient pathway*") AND TOPIC: (hospital*)

Refining the search

To refine the results from the database search, multiple refinement criteria were used. They were divided into three. What document types to include, language, and which topic categories to be included. For topic categories, a category was chosen if it could contain articles related to health care or performance management. Table 2.2.2 shows the search refinements used for the different databases.

Removal of duplicates

By comparing the search results from Scopus and Web of Science, 132 duplicate articles were found and removed from the article collection.

Table 2.2.2: Search refinements

Scopus	Inclusion criteria	Article, Conference Paper, Review, Book Chapter.
	Exclusion criteria	Non-English
	Categories chosen	Medicine, Engineering, Nursing, Business, Management and Accounting, Decision Sciences, and Multidisciplinary
Web of science	Inclusion criteria	Article, Proceedings paper, Review.
	Exclusion criteria	Non-English
	Categories chosen	Health care sciences services, Operations research management science, Emergency medicine, Management, Medical informatics, Critical care medicine, Surgery, Engineering multidisciplinary, Planning development, Automation control systems, Nursing, and Economics

Basic criteria

For the first round of screening the abstract, keywords, and other metadata of the articles were reviewed. The articles were excluded or included based on the basic criteria. If there were uncertainty related to the relevance of the article, the article was included. The basic criteria were as follows:

- Exclude: Articles not related to hospitals
- Exclude: Articles not related to the flow of patients
- Exclude: Articles not containing performance measuring

Advanced criteria for the outpatient line of inquiry

For the first part of the second round of screening, the entire article was reviewed. The articles included used performance measures for measuring and evaluating the patient flow at outpatient hospitals. The process was cumulative for the first and second screening, but not between the first and second part of the second screening. Hence both the criteria from the first

screening and the first part of the second screening were used to include or exclude articles. The criteria for the first part of the second screening were as follows:

- Exclude: Articles not containing performance measures related to outpatient patient flow
- Exclude: Articles without full text available

Advanced criteria for hospital line of inquiry

For the second part of the second screening round the whole article was read. The articles discussing what performance measures should be used for measuring patient flow at the hospital were included. The process was cumulative for the first and second screening, but not between the first and second part of the second screening. Hence both the criteria from the first screening and the second part of the second screening were used to include or exclude articles. The criteria for the second part of the second screening were as follows:

- Exclude: Articles not containing performance measures related to patient flow
- Exclude: Articles not discussing patient flow performance measuring
- Exclude: Articles without full text available

Findings

The findings of the structured literature review are shown in Figure 2.2.1. It shows how a total of 894 were reduced through multiple steps of refinement and screenings to two sets of articles. For the first line of inquiry, 18 articles were found, and for the second line, six articles were found.

Data extraction

For the articles in the first line, authors, release date, title, and the performance measures used were extracted. For the articles in the second line, a more thorough review was needed. Here, authors, release date, title, hospital subsystem, and the methodology and motivation were extracted. Thereby giving an overview of the most critical information during the writing of this paper.

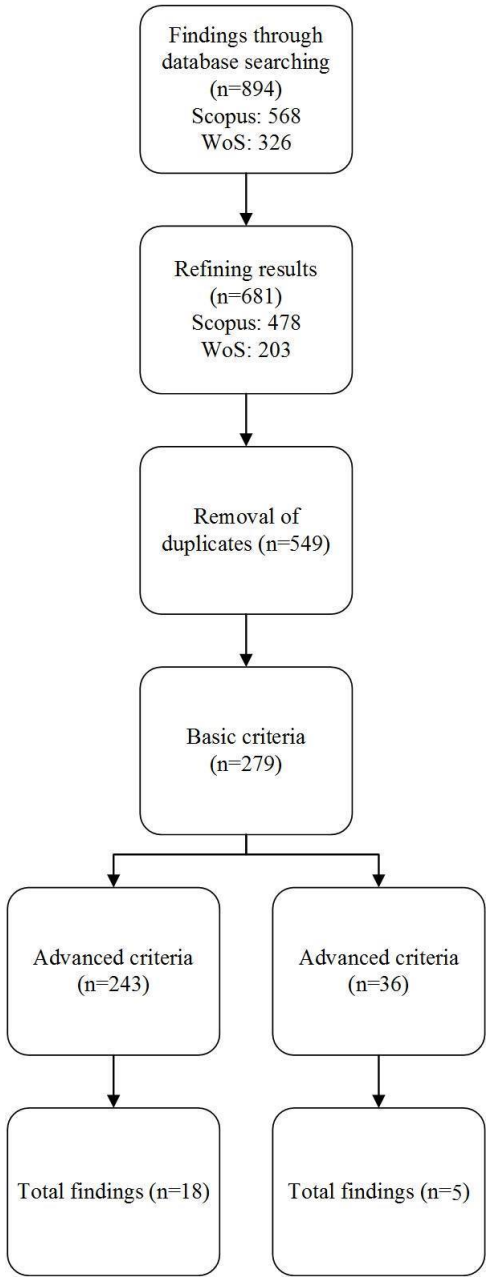

Figure 2.2.1: The result of each step of the structured literature study

2.2.2 Case study - Semi-structured interview

The second research method applied in this thesis was a case study. The purpose of the case study was to collect empirical qualitative data on a hospital's patient flow performance measurement system. Choosing a case study is particularly favorable when generating novel theory (Voss et al., 2002). A case study is a suitable method for obtaining data from actual practice where the phenomenon of interest occurs. As the theory-building process is so tightly interlined with empirical evidence, the resulting theory is likely to be consistent with reality, thus providing increased validity for the ultimate user of the research - the practitioner (Eisenhardt, 1989).

Case studies can be performed either with a single case or with multiple cases. A single case study leads to a more significant opportunity for depth in the research where several contexts within the case are studied simultaneously (Voss et al., 2002). Considering single case studies have limitations if generalization of the conclusion is sought as one single event may be misjudged or exaggerated (Voss et al., 2002), an embedded single-case design was chosen for this study. This design occurs when, within a single case, attention is given to sub-units (Yin, 2009). The case in the thesis is the Oslo University Hospital, with four staff members looked upon as sub-units. In this case study, semi-structured interviews were the data collection method.

Semi-structured interviews combine predefined questions with open-ended exploration. The general goal of the interviewer is to gather systematic information about a set of central topics, while also allowing some exploration when new issues or topics emerge (Wilson, 2014).

Case hospital and interview objects

When choosing the case hospital, it was necessary, as a single case study, to have a large scale hospital that offered a large selection of outpatient services. It was also essential for the case hospital to be able to provide multiple interview objects, to use the single-embedded case study design. Lastly, it was important that the interviewees had different positions within the hospital, to get a holistic view. The chosen hospital, Oslo University Hospital, OUS, fulfilled these criteria.

Norwegian hospitals have a strict organizational, hierarchical structure. This structure is represented in Figure 2.2.2. At the top are the hospital director and his or her staff. The next level is the divisions. The hospital is divided into a certain number of divisions that work mostly independent of

each other. The divisions are comprised of several different departments that often have one comprehensive medical discipline in common. The departments consist of different sections, which again are comprised of different operational units.

Doctors belong to departments and work across the different sections of the departments. Nurses and other medical staff belong to either sections or units and works within their entity. The divisions are divided between the large medical branches. The departments are separated into different medical disciplines; the sections are dived into smaller disciplines which again uses the units to divide the work into manageable and logical operational units. The separation of outpatient and inpatient services happens first at the section or unit level.

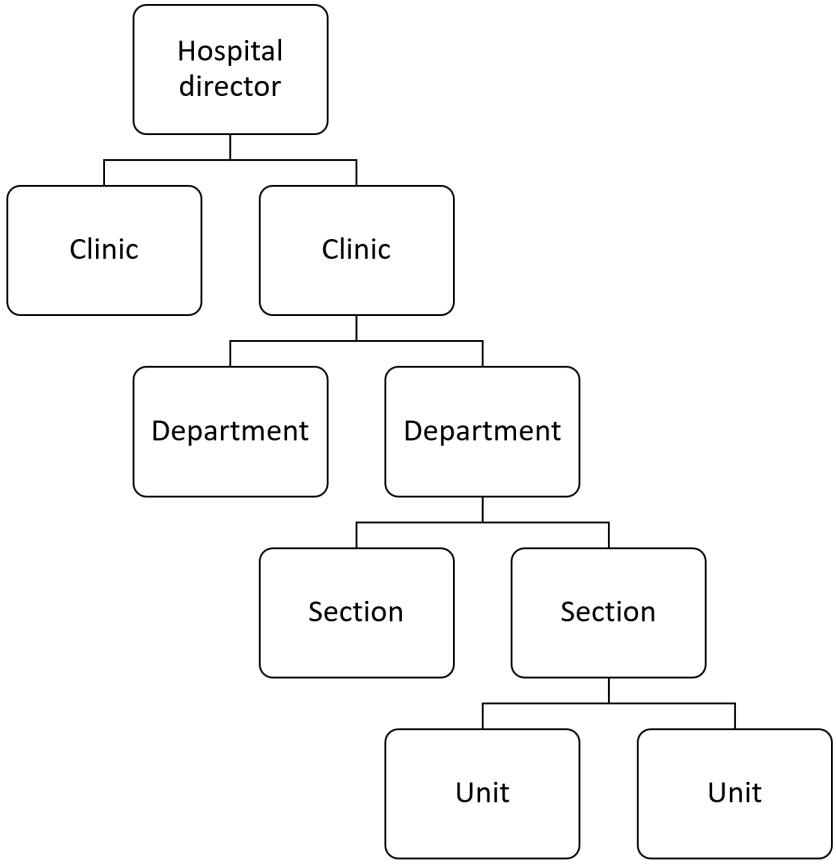

Figure 2.2.2: The hierarchical structure of a Norwegian hospital

This thesis collaborated with the Division of Head, Neck, and Reconstructive surgery at OUS. The division is comprised of 6 different departments that are described in Chapter 5. When choosing interview objects, it was essential to get a holistic view of the system from the different levels within the organization.

Four medical staff members with leadership positions at different organizational levels were chosen - one in the division management, one department leader, and two unit leaders. The choice to have two unit leaders stemmed from interview object 3's unique responsibilities. It was deemed necessary to also get the views of a unit leader without responsibilities connected directly with patient low. The interview objects are presented below.

Interview object 1 - Division management:

Interview object 1, IO1, is the financial manager for the Division of head, neck, and reconstructive surgery. The position's responsibilities include budgeting and following up the accounting, counseling of division leader, department leaders, and all line leader on financial matters.

He also works with following up on the activity. He tries to make the operations flow smoothly on both outpatient clinic projects and inpatient projects.

Interview object 2 - Department management:

Interview object 2, IO2, is the department leader for the department of day surgery, responsible for nurses and non-medical staff for the entire department consisting of 5 sections. Her responsibilities include management, administration, financial responsibilities, development of the department's disciplines, and the daily operations.

Interview object 3 - Unit leader:

Interview object 3, IO3, is the leader of the ear coordination unit in the office section of the ear nose and throat department in addition to being responsible for the wait list for the entire Ear, Nose, and Throat department.

Her responsibility as a coordinator is for the surgical patients of the ear section. The coordinating unit consists of coordinators for surgical patients, patients for CI assessments and follow-up, and the outpatient clinic patients. The coordination position is bifurcated, with both personnel administration and patient administration. The patient coordinating part also consists of giving the patients the right appointment at the right time.

As responsible for the wait list, she has the final responsibility for her department for the patient to be given the correct appointment at the correct

time, that they are correctly registered, and for there to be no time limit breaches. Time limit breaches are when a patient does not get an assessment or treatment within a medically decided time limit.

Interview object 4 - Unit leader:

Interview object 4, IO4, is the leader of the Hearing unit in the ear section of the Ear, Nose, and Throat department. She is in charge of the audiologists. She has managerial responsibilities for the audiologists. Those responsibilities encompass all personnel administration, financial responsibility for budgeting, and a control responsibility. She has the responsibility to ensure that the unit have the right amount of resources to serve the department.

The interview guide

The interview guide was structured after Andersen and Fagerhaug (2002)'s performance measurement system design process presented in Chapter 3. It contains five main topics of interest.

1. Mapping of position and structures

The first and introductory part. It focuses on getting to know the interview subject and its position, and on mapping and understanding the organizational entity the interview object works in.

2. Performance demands

The second part looks at the performance priorities. It maps the interview objects perception of the performance demands on the outpatient clinics the interview object works with.

3. Current system

The third part focuses on mapping the current performance measurement system. Looking at how performance is measured in the clinic, what data is collected, and how it is collected.

4. Performance indicators

The fourth part looks closer at the performance indicators. It examines the importance of the different indicators, and wants and needs for future indicators.

5. Reporting and presenting

The fifth part looks at the future performance measurement system. Who should use it, how should it be used, and how should it be presented.

The structure of the interview guide can be seen in Figure 2.2.3 and the complete interview guide can be found in Appendix B.

The results of the interviews are given in Chapter 5, where the answers to the first topic is presented in Chapter 5.1, and Chapter 5.2 is divided into the four remaining topics of interest.

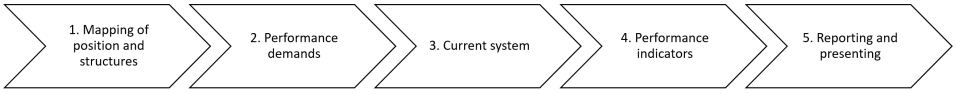

Figure 2.2.3: Structure of the interview guide

Performance measurement theory

In this chapter, the theory of performance measurement is presented. The chapter looks at performance measurement theory and performance measurement system design. At the end of the Chapter, it's shown how the various criteria and framework will be used later the thesis

3.1 Performance measurement and the performance measurement system

Both Slack (2010) and Neely et al. (1995) define performance measurement as the process of quantifying action. From a marketing perspective, organizations perform by satisfying their customers with greater effectiveness and efficiency than their competitors. In this setting, efficiency is how economically the resources are utilized, while effectiveness refers to the extent to which customer requirements are met. Thus, when an action leads to a result, quantifying the efficiency is quantifying the action and quantifying the effectiveness is quantifying the result. This also aligns with Fitzgerald et al. (1991)'s view that there are two basic types of performance measures - those that relate to results, and those that focus on the determinants of the result.

To further explain performance measurement, Neely et al. (1995) defines a performance measure as a way to quantify the efficiency and effectiveness of the action. Slack (2010) puts performance measures in a pyramid that aggregates the measures. It goes from detailed performance measures with high diagnostic power and frequency of measurement, to brad strategic measures with high strategic relevance and aggregation. This thesis does not

focus on the individual, detailed measures, but on more aggregated groups of measures, measuring one thing. To demonstrate this difference, the thesis will use performance measure when discussing detailed measures, and performance indicators, PIs, when discussing groups of detailed measures.

Neely et al. (1995) defines a performance measurement system, PMS, as the set of measures used to quantify both the efficiency and effectiveness of action. Combining this with Slack (2010) definition of key performance indicators, KPIs, as the most important measures used to align the performance measurement with the strategic goals, this thesis defines the PMS as a set of KPIs.

Without performance measurement, it would be impossible to exert any control over an operation on an ongoing basis Slack (2010).

3.2 Performance measurement system frameworks

The balanced scorecard

Kaplan and Norton (1992)is generally evaluated as the best-known framework. It is split into four perspectives: the financial perspective, the internal business perspective, the innovation and learning perspective, and the customer perspective. These four perspectives are meant to answer four questions for managers regarding performance. The framework with the perspectives and questions can be seen in Figure 3.2.1.

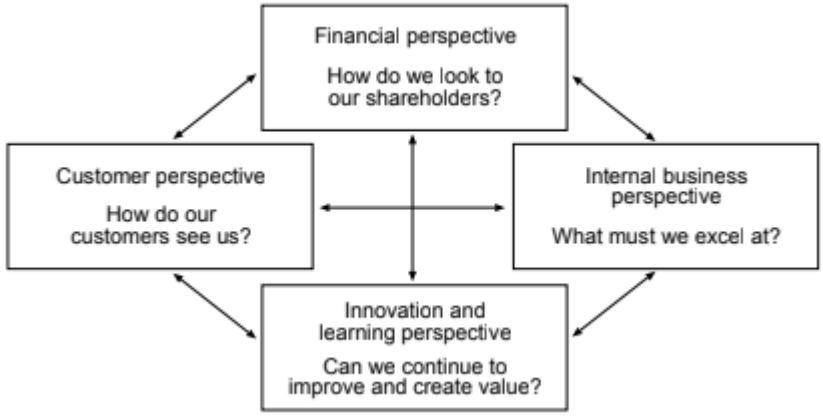

Figure 3.2.1: Framework for performance measurement system. Adapted from Kaplan and Norton (1992) and Neely et al. (1995)

Kaplan and Norton (1992)'s framework answers the question of what types of performance indicators are needed in a performance measuring system.

The Donabedian method

When it comes to methods for choosing measures for assessing the quality of care, the Donabedian method is one of the most used in health care. It uses three categories to divide the measures; Structure, the attributes of the setting in which care occurs; Process, what is done in giving and receiving care; Outcome, the effects of care on the health status of patients(Donabedian, 1988). The method is illustrated in Figure 3.2.2. The model is linear where the idea is that good structure increases the likelihood for good processes, and further, that good processes increases the likelihood of good outcomes. A more comprehensive description of the three categories and how to choose measures for them follows.

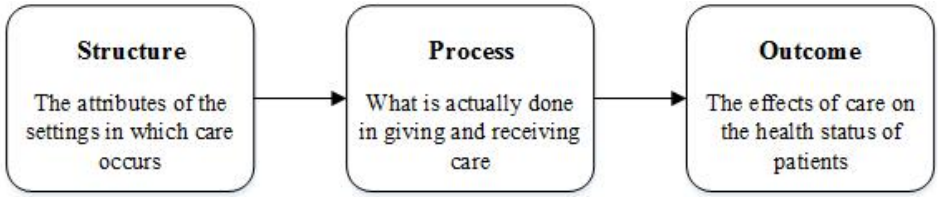

Figure 3.2.2: The Donabedian model for evaluating the quality of medical care. Adapted from Donabedian (1988)

Structure

Studying the structure is meant to ensure the best foundation for the other two categories to succeed. In addition to including the physical amenities, it includes administrative measures and the related processes that support and direct the provisions of care. Usual measures can be adequacy and capacity of facility and equipment, staff qualifications, and administrative structure(Donabedian, 2005).

Process

The process category examines the process of care itself and whether what has been stated as "good" medical care, has been applied. Process measures might include, in addition to the physical examinations, tests, procedures, the completeness of the information from the clinical history, and the acceptability of care to the patient. These measures are less stable and final than outcome and structure measures and require the specification of values and standards(Donabedian, 2005).

Outcome

Outcome measures deal with the effects on the health status of the patients. It is often measured in terms of recovery, restoration of function, and survival. Donabedian (2005) argues that outcomes might be the ultimate validator for the effectiveness of medical care, but that there are some limitations and constrictions. Examples of these limitations can be time, that to measure the final outcome might take years and the fact that many factors affect outcomes making it hard only to measure the effectiveness of the medical ones.

3.3 Choosing the KPIs

Slack (2010)'s five performance objectives and typical performance measures for operations management

In (Slack, 2010)'s definition of performance, it is defined as the degree to which an action satisfies the customer by fulfilling five performance objectives:

- Cost
- Dependability
- Flexibility
- Quality
- Speed

Some of the typical measures that are used in operations management and divided into the five different objectives can be seen in Table 3.3.1.

Neely et al. (1995) four performance measurement categories

Neely et al. (1995), on the other hand, divides the performance measures into quality, time, flexibility, and cost. In this division, the speed and dependability category has converged to one only dealing with time, while the measures which do not fit this new category have been moved into the category that gives the best fit. Both, Neely et al. (1995) and Slack (2010) foremost look at the manufacturing environment.

Fitzgerald et al. (1991)'s two measure types

Table 3.3.1: Some typical performance measures for operations management. sourced from Slack (2010)

Performance objective	**Some typical measures**
Quality	Number of defects per unit Level of customer complaints Scrap level Warranty claims Mean time between failures Customer satisfaction scores
Speed	Customer query time Order lead time Frequency of delivery Actual versus theoretical throughput time Cycle time
Dependability	Percentage of orders delivered late Adverage lateness of orders Proportion of products in stock Mean derivation from promised arrival Schedule adherence
Flexibility	Time needed to develop new products/services Range of products/services Machine changeover time Average batch size Time to increase activity rate Average capacity/maximum capacity Time to change schedules
Cost	Minimum deliver time/average delivery time Variance against budget Utilization of resources Labour productivity Added value Efficiency Cost per operation hour

For the service sector, Fitzgerald et al. (1991) suggests only two. Measures that relate to results and measures that relate to the determinants of the results. I.e., Competitiveness and financial performance for the former, and quality, flexibility, resource utilization and innovation for the latter.

3.4 Developing the PMS

Andersen and Fagerhaug (2002)'s PMS design process

There are eight steps in the performance system design process proposed by Andersen and Fagerhaug (2002). The process can be simplified both in its reasoning behind the step and also as a process in the whole by combining some of the steps. This has been done when adapting this process for the thesis.

1. Understanding and mapping business structures and processes
2. Developing business performance priorities
3. Understanding the current performance measurement system
4. Developing performance indicators
5. Deciding how to collect the required data
6. Designing reporting and performance data presentation formats
7. Testing and adjusting the performance measurement system
8. Implementing the performance measurement system

The first step is the introductory step of the design process. Its primary purpose is for the designer to acquaint themselves with the organization, its competitive position, the environment it exists in, and its business processes (Andersen and Fagerhaug, 2002).

The second step seeks to develop and understand the business performance priorities so that the system can support the chain of stakeholders' requirements from the organization's strategy through to its business processes (Andersen and Fagerhaug, 2002).

The third step is to understand the current system. Even if it is not called a performance measurement system, every organization has some kind of

measurement system in place. Understanding the current system, and using this as a base for the new system is recommended by (Andersen and Fagerhaug, 2002).

The fourth step is to decide on the performance indicator used in the performance measurement system. The purpose of this step is to develop the performance measurement system, with an appropriate amount of relevant and precise performance indicators (Andersen and Fagerhaug, 2002).

The fifth step is ensuring that the system can collect the data required to calculate these performance indicators. This issue must initially be addressed during the development of the performance indicators to avoid those that can never be measured (Andersen and Fagerhaug, 2002). For this thesis, the fifth step will fall under the third step of understanding the current system, since finding the possible performance measurement data is a part of how the current system works.

The sixth step is deciding how the performance data will be presented to the users; how they should apply the performance data for management, monitoring, and improvement; and who will have access rights to performance data. The result of this step should be a performance measurement system that as found its place in the overall measurement-based management system (Andersen and Fagerhaug, 2002)

The seventh and eight steps fall outside of the thesis scope by focusing on testing and implementation of the system. Due to time constraints, it will not be possible to do this.

3.5 Summary

Table 3.5.1 sums up the theory discussed in this chapter and shows how the criteria and frameworks will be used for discussing the PMS of RO2.

Table 3.5.1: Summary of performance measurement theory

Framework or criteria	**Used to**
Slack (2010)'s five performance objectives	To ensure that the system is holistic by having measures that fulfill all five objectives
Slack (2010)'s list of typical performance measures	To see how the KPIs compare to the typical performance measures of operations management
Neely et al. (2000)'s four performance measurement categories	To ensure that the system is holistic by having measures that fit all four categories
Fitzgerald et al. (1991)'s two types of performance measures	To ensure that the system is holistic by having measures that fit both types
Kaplan and Norton (1992)'s balanced scorecard	To compare to see if it is a good fit for a PMS framework for outpatient clinic patient flow
Donabedian (1988)'s method for health care measures	To see if the system is holistic by having measures in all three categories and to compare to see if it is a good fit for a PMS framework for outpatient clinic patient flow
Andersen and Fagerhaug (2002)'s system design process	To develop the system design process

Performance measurement of patient flow in existing literature

In this chapter, existing literature on patient flow performance measurement is examined. The first section looks at patient flow performance at outpatient clinics patient, while the second section examines the performance measurement systems and frameworks used in the existing literature. Lastly, the chapter summarizes the findings and discusses how they can be used later in the thesis.

4.1 Performance measurement of patient flow at outpatient clinics

The result of the first line of inquiry for the structured literature study contained 18 articles using patient flow PIs. The performance indicators specific for outpatient patient flow can be seen in Table 4.1.1. Here the measures are presented, along with a definition of the types of individual measures, how they are measured, and the abbreviation used for the measure in this thesis.

Table 4.1.1: The PIs found for in outpatient patient flow performance research

PI	Definition	How to measure	Abbreviation
Door-to-event time	The time from a patient is registered or admitted until a certain event has taken place. Can also be called Door-to-bed, door-to-doctor, door-to-surgery, door-to-order.	Minutes, hours	DTE
Length of stay	The length of stay for a patient at a ward, a department, or the entire hospital stay. Measured from time of admittance or registration, until discharged. Can also be called ALOS (average length of stay), turnaround time, patient lead-time, door-to-discharge.	Hours, days	LOS
Patient satisfaction	A survey measuring patient satisfaction on the patient flow	Presented as a percentage score	PS
Resource utilization	Utilization levels of hospital resources such as physicians, nurses, beds, treatment rooms, equipment.	% out of full utilization	RU
Service time	The time it takes to complete one service. Can also be measured in how many times one service can be done in a time frame. Can also be called service rate, cycle time.	Minutes, hours, times per hour	ST
Staff overtime	Time a staff member must work beyond the set work hours	Minutes, hours	SO
Throughput	The patient throughput of a ward or department. The capacity of the outpatient clinic.	Patients per hour, number of patients	T
Wait time before the hospital	The time a patient waits before hospital admittance or an outpatient appointment. Can also be called Referral-to-first-treatment	Days, hours	WTB

PI	Definition	How to measure	Abbreviation
Wait time in hospital	Patient wait time is the time a patient waits for hospital resources such as a nurse, a physician, or a bed. Is usually measured as an average for all patients within a group and a time frame.	Minutes, hours	WTH
Waiting queue	The population of patient queuing for hospital resources	Number of patients in queue	WQ

Table 4.1.2 shows have many times the different measures where used, and which articles used them.

Table 4.1.2: The PIs found in existing literature

PI	No.	Study
Door-to-event	1	Zhu et al. (2013)
Length of stay	3	Alamo et al. (2013), Davis et al. (2016), Edward et al. (2008)
Patient satisfaction	1	Alamo et al. (2013)
Resource utilization	3	Bhattacharjee and Ray (2014), van Lent et al. (2009), Zhu et al. (2013)
Service time	7	W Antle and A Reid (1988), Chen et al. (2017b), Davis et al. (2016), Edward et al. (2008), Edwards et al. (1994), Morikawa et al. (2018), Zafar et al. (2016)
Staff overtime	4	Bhattacharjee and Ray (2014), Chand et al. (2009), Lin (2015), van Lent et al. (2009)
Throughput	4	Bhattacharjee and Ray (2014), Davis et al. (2016), Drupsteen et al. (2013), van Lent et al. (2009)
Wait time before the hospital	4	Bhattacharjee and Ray (2014), Drupsteen et al. (2013), Fung-Kee-Fung et al. (2018), Hall et al. (2006)
Wait time in hospital	13	Alamo et al. (2013), W Antle and A Reid (1988), Bhattacharjee and Ray (2014), Chand et al. (2009), Davis et al. (2016), Drupsteen et al. (2013), Edward et al. (2008), Edwards et al. (1994), Hall et al. (2006), Lin (2015), Morikawa et al. (2018), Zafar et al. (2016), Zhu et al. (2013)
Waiting queue	4	Chen et al. (2017a), Chen et al. (2017b), Edwards et al. (1994), Lin (2015)

4.2 Performance measurement systems for patient flow at hospitals

The result of the second inquiry line of the structured literature study contained five articles with patient flow PMSs. To structure this section, the articles have been divided into those with performance indicator for the entire hospital, and those directed at specific subsystems.

The hospital

two articles give performance measurement systems for multiple subsystems of the hospital. Martinez et al. (2018) looks at performance measures for the emergency department, the inpatient wards, and the surgery wards, while Villa et al. (2014) look at the flow through the entire hospital.

Martinez et al. (2018) identified ten performance indicators for patient flow, dividing them into the three categories of the Donabedian framework of measuring the quality of care. Outcome (length of stay, 30-day readmission, operating room exit delays, capacity-related diversions), process (timely inpatient unit discharge, emergency department disposition), and structural metrics (occupancy, discharge volume, boarding, bed assignation duration). The system looks at three of the hospital subsystems: the emergency department, the surgery ward, and the inpatient department. Also, the system takes into account the stakeholder for the system and identifies three different users: unit leadership, service leadership, and institutional leadership. For the three leadership levels used, the unit leaders correspond to the unit leaders of the Norwegian hospital structure shown in Figure 2.2.2, the service leaders equals the department leaders, and the institutional leaders equal the division leaders and the hospital director. The PMS was built through semi-structured interviews with the hospital leadership and the service and unit managers. The results are summarized in Table 4.2.1.

Table 4.2.1: User needs and performance measure of the electronic hospital capacity dashboard. Users: U, unit leadership; S, service leadership; I, institutional leadership. Sourced from: (Martinez et al., 2018)

		Emergency department	Inpatient floor	Perioperative Area
Outcome	30-Day Readmission Rate		I	
	Length-of-Stay	S	U I	U
	Operating Room Exit Delay Volume and Duration			U S I
	Capacity-Related Diversions Volume and Duration		U I	U
Process	Timely Discharge Order Rate		U S	U
	Timely Discharge Rate		U S	U
	ED Disposition Duration	U I		
Structure	Hourly Bed Occupancy Rate		U S I	U S
	Hospital Discharge Volume		U S I	U S
	ED Boarding Duration	U S I	U I	
	ED Visits Volume	U S I		
	Inpatient Bed Assignation Duration	U I		

The performance measures of Table 4.2.1 can be categorized into the following performance indicators. Length of stay is Length of stay, Capacity-Related Diversions Volume and Duration and the ED Visit Volume can be seen as measures for Throughput and ED Disposition Time, the time from arrival until a decision has been made to either discharge or admit, can be classified as Door-To-Event.

The other measures can be categorized like this. Timely Discharge Order Rate, Timely Discharge Rate, and Hospital Discharge Volume can be seen as

measures for a Discharge performance indicator. 30-Day Readmission Rate is a performance measure for a Readmission PI. Hourly Bed Occupancy Rate can be seen as a performance measure for Occupancy. ED Boarding Duration and Inpatient Bed Assignation Duration fall under a Boarding time PI (BT). Lastly, Operating Room Exit Delay Volume and Duration is a performance measure for Access block(AB).

Villa et al. (2014) identified 14 performance measures divided into three different levels: the hospital-wide system, the pipelines (patients' physical journeys through the hospital), and the production units(physical spaces where service delivery takes place). The framework developed by the author is presented in Figure 4.2.1. It shows the level, the focus of the patient flow at that level, and the possible indicators used. The article uses a literature review and a case study of six Italian hospitals, the foremost to develop the framework and the latter to validate it.

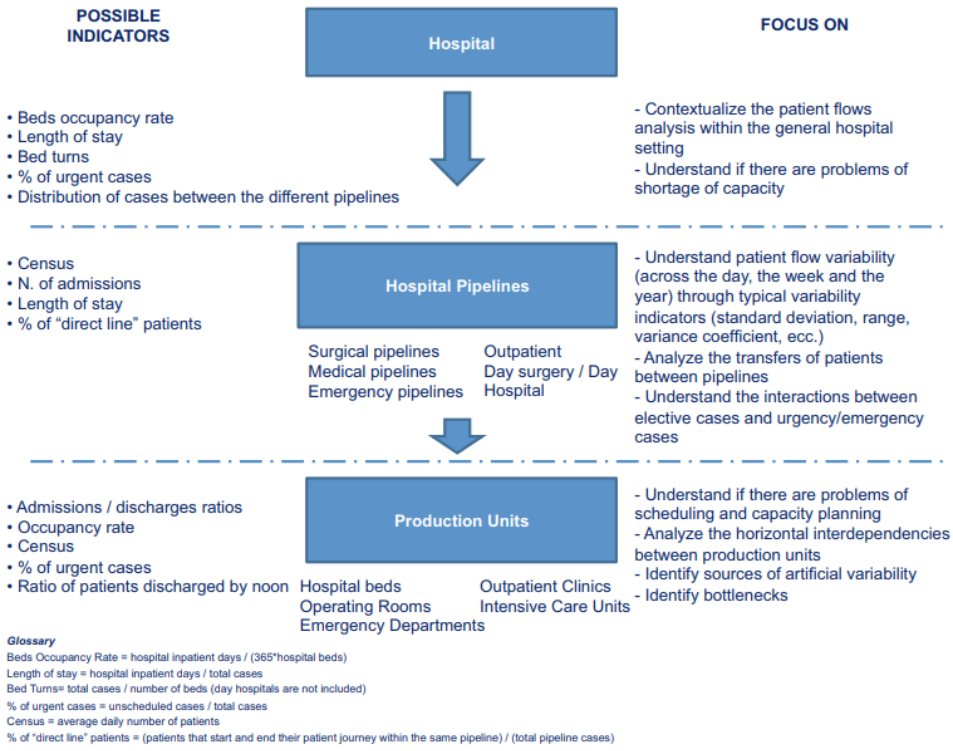

Figure 4.2.1: Structure of analytical framework to measure patient flows logistics. Sourced from: (Villa et al., 2014)

Some of the performance measures seen in Villa et al. (2014) can be classified by the already established performance indicators found in Table 4.1.1. These are Length of stay and Bed turns, census and Number of admission, as throughput measures. Admissions/Discharge ratios, Beds occupancy rate, Percentage of urgent cases, Distribution of cases, and Percentage of "direct line" patients are all new and falls under none of the PIs discovered for RQ1.

The emergency department

Two articles only focused on the ED subsystem.

Khalifa and Zabani (2016) identified 34 performance measures for emergency department performance and sorted them into three patient flow components: input, throughput, and output. These performance measures are presented in Table 4.2.2. To decide on the performance measures for the study, the authors looked at the literature, conducted semi-structured interviews with ER and health care leaders, and looked at data collected from ER encounters over two years, analyzed for measurable and significantly meaningful variables. Even though the article looks at a PMS for the emergency departments performance because it is sorted by patient flow components and measured by patent flow data it can reasonably be said that it is a usable PMS for emergency department patient flow as well.

Table 4.2.2: ER performance measures sorted into; input, throughput and output indicators. Sourced from: (Khalifa and Zabani, 2016)

Categories	S/N	Performance measure
A - Input Indicators	1	Total Number of ER Visits
	2	Average Daily ER Visit
	3	Percentage of Leaving Before Screening
	4	Percentage of Leaving Without Being Seen
	5	Percentage of Revisits to ER within 3 days
	6	Percentage of Revisits to ER within 7 days
	7	Average ER Patients Acuity Level
	8	Differential Percentages of ER Patients Acuity Levels
B - Throughput Indicators	1	Length of Stay - All ER Patients
	2	Length of Stay - Patients Discharged Home
	3	Length of Stay - Patients Admitted to Hospital
	4	Percentage of ER Patients with LOS More than 6 hours
	5	Average Number of ER Patients Waiting for Treatment
	6	Average Registration Time
	7	Average Arrival to Triage Time
	8	Average Triage to Bed Time
	9	Average Bed to Doctor Time
	10	Average Door to Doctor Time (Waiting Time)

Categories	**S/N**	**Performance measure**
	11	Average Doctor Examination to Decision Made (Treatment Time)
	12	Percentage of Patients Leaving Before Complete Treatment
	13	Average ER Lab Request Turnaround Time
	14	Average ER Radiology Request Turnaround Time
	15	Average ER Medications Request Turnaround Time
	16	Average Number of Active ER Beds
	17	Average Number of ER staff
	18	Ratio of Daily ER Patients to ER Beds
	19	Ratio of Daily ER Patients to ER Staff
C - Output Indicators	1	Doctor Decision to Patient Discharge (ER Bed Turnaround Time)
	2	Doctor Decision to Patient Admission (Inpatient Boarding Time)
	3	Percentage of ER Patients Admitted to Hospital
	4	Percentage of ER Patients Discharged Home
	5	Average Number of ER Patients Waiting for Admission
	6	Average Available Inpatient Beds
	7	Average Available ICU Beds

The performance measures of Khalifa and Zabani (2016) presented in Table 4.2.2 can be translated into the already discovered performance indicators, as shown in Table 4.2.3. The performance measures that do not fall into a category is comprised and mentioned under Other.

Table 4.2.3: Translation of performance measures from Khalifa and Zabani (2016) to the KPIs of this study

The KPI from this study	Performance measure from Table 4.2.2
WTH	10B
LOS	1B, 2B, 3B, 4B
DTE	7B, 8B, 9B
T	1A, 2A, 16B, 17B, 6C, 7C
WQ	5B, 5C
LWBS	3A, 4A, 12B
ST	6B, 11B, 13B, 14B, 15B
RU	18B, 19B
Boarding time	2C
Other	Patient acuity levels (7A, 8A) Admission and discharge(1C, 4C, 3C) Readmission (5A, 6A)

Stefanini et al. (2018) sets out to measure ED performance, mainly by analyzing the patient flow. The authors focus on the process indicators of the Donabedian framework. Arguing that while past studies mainly focus on input and output indicators, process indicators can best figure out eventual local weaknesses and bottlenecks within the patient flow and their impact on the patient's total time in the ED. The resulting 20 indicators are shown in Figure 4.2.2. They are divided into two categories, patient-related indicators, and process indicators. For this study, the second category's time measure is the one that is mentioned in relation to patient flows and therefore included in this study. In conclusion, Stefanini et al. (2018)'s recommended performance measures for patient flow at emergency departments can be translated into the PIs Length of stay, Door to event, and Service time.

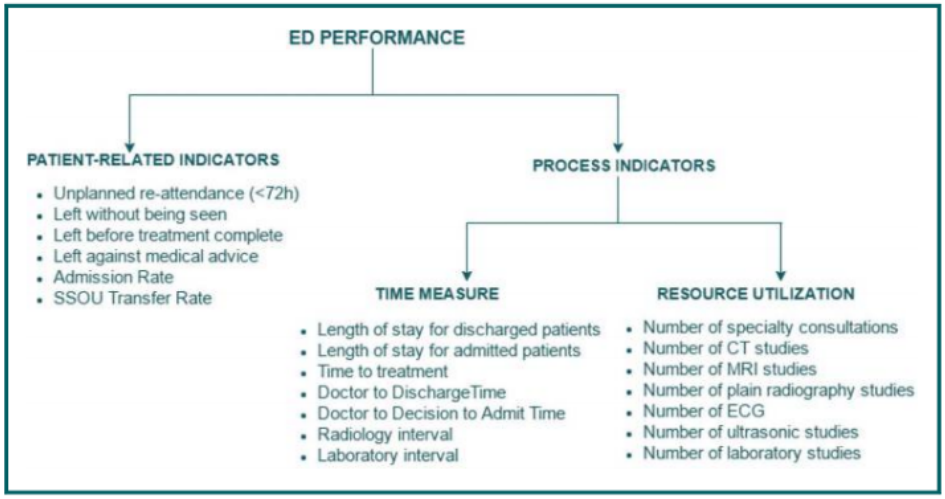

Figure 4.2.2: ED performance indicators. Sourced from: (Stefanini et al., 2018)

The surgery wards

For the surgery wards subsystem, there was one article that had it as its focus. In the article by De Pourcq et al. (2016), the balanced scorecard framework is used for deciding on which performance measures to choose when developing an operational dashboard to coordinate and optimize patient, material, and information flow.

The case used in De Pourcq et al. (2016) was of hip surgery, focusing on the process within the operation room. The goal of the case study was to verify the method for choosing which performance measures should be measured, monitored, and implemented in the health care service operations dashboard. One hundred thirty-eight performance measures were presented, clustered into 24 indicators, and divided into the four variables of Kaplan and Norton (1992)'s balanced scorecard. To select the most relevant performance measures, both semi-structured and structured interviews were held with the different stakeholders involved in the hip surgery process. Twenty performance measures were chosen in the end, out of which 8 were patient flow related. Most of the performance measures fell under the customer, or patient perspective, with the performance measures: Post-operative evaluation of functional status, Infections, Number of hospitalization days (LOS), Mortality rate, Wait time for surgery(WTH), Unplanned readmission(R). The remaining two performance measures fell under the internal business

process perspective: Occupancy OR(O) and Duration of operating time per physician(ST).

4.3 Summary

RO1

Two different sources were used to find performance measures from theory - measures used across the hospital, and at different subsystems, and measures used for outpatient clinics. Table 4.3.1 summarises what hospital subsystems the articles have focused on, and presents the performance indicators found in relation to those subsystems. Here the performance measures found that could be classified into the categories presented in Table 4.1.1 are presented by their abbreviations, while the others by name.

Table 4.3.1: Summary table for the performance indicators found for the hospital and the other subsystems

Article	Hospital subsystems	PIs
Martinez et al. (2018)	ED	LOS, T, DTE, Boarding time
	S	LOS, T, Discharge and admittance, Occupancy, Access block
	I	LOS, T, Discharge and admittance, Occupancy, Boarding time, Readmission
Stefanini et al. (2018)	ED	LOS, DTE, ST
Khalifa and Zabani (2016)	ED	WTH, LOS, DTE, T, WQ, ST, RU, Readmission, Boarding time, Discharge and admittance, Left without being seen, Patient acuity levels
De Pourcq et al. (2016)	S	LOS, WTH, ST, Occupancy, Mortality, Readmission, Post-operative evaluation of functional status, Infections
Villa et al. (2014)	H	LOS, T, Occupancy, Discharge and admittance, Percentage of urgent cases, Distribution of cases, Percentage of "direct line" patients

Table 4.1.2 summaries the indicators found for outpatient patient flow performance. While Table 4.3.2 shows the list of all performance indicators found. All performance indicator mentioned more than once have been

included.

Table 4.3.2: The performance indicators found in existing literature

PI group	Definition	How to measure	Abbreviation
Boarding time	The time from the decision to admit a patient to the hospital from the ED to the patient is moved from the ED	Minutes, hours	BT
Discharge and admittance	Performance measures related to discharge from or admittance into a subsystem. Can relate to the discharge or admittance rate of a ward or the discharge or admittance time, i.e., the number of patients discharged at discharge time, the average delay from discharge time or to admittance, the average number of patients admitted	Number of patients, minutes, hours	DA
Door-to-event time	The time from a patient is registered or admitted until a certain event has taken place. Can also be called Door-to-bed, door-to-doctor, door-to-surgery, door-to-order.	Minutes, hours	DTE
Length of stay	The length of stay for a patient at a ward, a department, or the entire hospital stay. Measured from time of admittance or registration, until discharged. Can also be called ALOS (average length of stay), turnaround time, patient lead-time, door-to-discharge.	Hours, days	LOS
Occupancy	The patient occupancy level of a ward or department	Percentage of beds filled	O
Readmission	Patients that return to the hospital for the same illness in a certain time frame	Percentage of patients discharged, number of patients	R
Resource utilization	Utilization levels of hospital resources such as physicians, nurses, beds, treatment rooms, equipment.	% out of full utilization	RU

PI group	Definition	How to measure	Abbreviation
Service time	The time it takes to complete one service. Can also be measured in how many times one service can be done in a time frame. Can also be called service rate, cycle time.	Minutes, hours, times per hour	ST
Staff overtime	Time a staff member must work beyond the set work hours	Minutes, hours	SO
Throughput	The patient throughput of a ward or department. The capacity of the outpatient clinic.	Patients per hour, number of patients	T
Wait time before the hospital	The time a patient waits before hospital admittance or an outpatient appointment. Can also be called Referral-to-first-treatment	Days, hours	WTB
Wait time in hospital	Patient wait time is the time a patient waits for hospital resources such as a nurse, a physician, or a bed. Is usually measured as an average for all patients within a group and a time frame.	Minutes, hours	WTH
Waiting queue	The population of patient queuing for hospital resources	Number of patients in queue	WQ

RO2

Table 4.3.3 sums up the PMSs discussed in this chapter and shows how they will be used for discussing the PMS of RO2.

Table 4.3.3: Summary of patient flow PMS

Framework or criteria	**Aspects to discuss**
Martinez et al. (2018)	The role-specific performance indicators
Villa et al. (2014)	The three level hospital view
Khalifa and Zabani (2016)	A PMS using input, throughput, and output
Stefanini et al. (2018)	A PMS using the Donabedian framework, with a focus on process indicators
De Pourcq et al. (2016)	A PMS using the balanced scorecard framework

Case

This chapter presents the case study hospital and gives the result of the semi-structured interviews. The result section recounts the answers to the semi-structured interviews. The answers are divided into the last four focus parts of the interview guide.

5.1 Case company

This section introduces the case company.

The Norwegian health care system is semi-decentralized with the municipalities being responsible for primary care, and the state is responsible for specialist care. The specialist care is administered by four Regional Health Authorities, RHAs Ringard et al. (2013). OUS lies in the RHA Helse Sør-Øst and is the regions primary hospital. It also works as the local hospital and emergency hospital for part of Oslo's population and offers several services on a national levelOslo universitetssykehus.

The hospital is the largest hospital in Norway with 23 000 employees and a 22 billion NOK budget. For 2017 there were 835 458 outpatient consultations at the hospital.

The hospital consists of 14 divisions across six different hospital campuses. Its organizational structure can be seen in Figure 2.2.2 in Chapter 1. This study has cooperated with the Division of Neck, Head, and Reconstructive surgery and their outpatient services. The division consists of 6 different departments

Department for plastic and reconstructive surgery Highly specialized surgical activity, research, and education that is specifically directed towards innate divergence and reconstruction after removal of cancer,

innate deformations, infections or damage, as well as skin and soft tissue damage.

Department of pediatric surgery Attends to most children that needs surgical treatments at OUS.

Department of day surgery Examine and treat adults and children with surgical afflictions. All treatment is done as outpatient treatments or day treatments.

Jaw and face surgery department Treatment of patients with facial fractures or wounds after accidents or damage, as well as surgeries due to skeletal deviations in the face, such as over or under bite, facial asymmetric, and reconstructions to soft tissue in the face.

Ear, Nose, and Throat department Treats ear, nose, and throat diseases and cancers.

Eye department Treats diseases of the eye.

The eye and jaw departments are at the Ullevål campus, while the other departments are mainly based at the Rikshospitalet campus. All the departments, except for the day surgery department, has their own assigned spaces. The day surgery department shares its outpatient clinic space with four other divisions. Most of the specialized rooms are dedicated to one discipline, but many of the generic rooms are rotated. Some rooms are dedicated to one discipline, while some are rotated. However, they rarely rotate rooms between the sections, and who has the room is always by fixed times.

There are two main systems used by the hospital, the LIS-system and the DIPS-system. LIS is the management tool where reports and analyses, waiting lists, finances, project information, and other management information is made available. DIPS is a resource control tool. It is the system where patients are registered with their appointments. It contains both patient information and appointment information, such as which doctor had the appointment and the appointment's duration.

IO1 estimates there to be approximately 90 treatment rooms for the outpatient services of the Division of Head, Neck and Reconstructive surgery. Out of these, there are six specialization rooms and 44 generic treatment rooms for the outpatient clinic of the division. While the rest belong to the eye department, which has its outpatient clinic at Ullevål. He also mentions that there are probably more rooms, such as offices, that are also used as treatment rooms.

Since the doctors rotate between tasks, and none of them work full time in the outpatient clinic, the number of doctors is counted in one-year full-time equivalents. There are about 100 doctors and 92 nurses when counting this way. There are also around 70 interns. However, the doctors work a little more than a one-year full-time equivalent due to their extended work hours. They work on the average about 1.2 one-year full-time equivalents in a year. Therefore, there are slightly fewer doctors.

When it comes to the average consultation time, IO1 operates with about 30 min. From the DIPS system, he can see that the median of consultation time also is about 30 min. However, though this is supposed to show the actual time spend in consultation, it is usually only planned time that is registered. There is also a big difference between the average consultation time of a new patient as opposed to the average time of a recurring patient. IO3 says that the doctors have an average consultation time of 20 min, with some exceptions that have 30 min. The different disciplines have different times, which can vary between 30 min and over an hour.

The division's outpatient clinics are open from 8 am to 3.30 pm. However, the operations and the appointments usually do not start until closer to 8.30 to 9 am because the doctors have daily morning meetings.

Responsibility for patient flow performance

According to IO2, it is the administrative leader in the division management who is responsible for the patient flow performance. She presents the results regarding epicrises, number of consultations and operations, and the financial situation at the department managerial meetings. The numbers she presents are collected from the LIS-system.

When it comes to responsibility for the patient flow, IO3 says that it correlates predominantly to her role as coordinator. It is chiefly up to her unit with the help of her section leader. She says that it is the department head that has the primary responsibility and the responsibility of delegating it downwards. One way of doing this has been to give every department a person responsible for the waiting list. They look to see if the sessions are filled up. They have a requirement from the Norwegian Ministry of Health and Care Services to fill up their sessions.

IO4 says that outpatient performance is the responsibility of all management levels. The responsible party for patient flow is at the managerial level one looks at. The unit leaders are responsible for the flow of their unit, section leaders for the flow of their section with its combined units, department

leaders for the flow of the department with its combined sections, and the division leaders for the entire division's flow.

While IO4 says that she is responsible for her unit's flow, she also points out that there are issues since her unit collaborates so closely with other units and disciplines. As well as needing one of her audiologists, she is dependent on resources such as doctors, speech and language therapists, and audio physicists. Since other units control the other resources, she can only control the audiologists and therefore only be responsible for the patient flow of the audiologist service. She says that the unit cannot be viewed on its own like a satellite but must be put into a system with its collaborative units to be able to see the entire patient flow. Her manager, the section leader, will therefore overall be responsible for the flow of her unit, making sure that all the units collaborate to provide a smooth flow.

Even though the ear coordinators belong to another section than the ear section, it is they who arrange for the patients' appointments and make sure that the patients stop by all the disciplines during the visit. So, while IO4 is responsible for the part of the patient journey that is at the hospital, it is IO3 that is responsible for the patient getting through the entire journey.

Patient flow problems and bottlenecks

IO1 identifies some patient flow bottlenecks. The most obvious one, he says, is the lack of surface area. It is a big hinder for the division capacity. The eye department has a different and more singular problem with its AMD treatments. AMD treatments are for age-related macular degeneration of the eye. Patients with the illness need injections every six weeks to retain their vision. The hospital started offering the treatments in 2007, and it is today taking up a large amount of the department's capacity. All Norwegian hospitals are struggling with being able to offer the service as it is so time-consuming. It affects the services of the outpatient clinic by taking up resources.

IO2 identifies three bottlenecks when asked about patient flow. The first bottleneck comes from the shared testing and medical equipment such as the MRI and X-ray machines. The second is the planning of the doctors' attendance, when they plan and have their outpatient hours, is difficult for her to plan around. The third bottleneck appears in when patients cancel last minute. Patients canceling last minute is a bigger problem than patients not showing up. When a patient gets an appointment at the clinic, multiple resources are organized around that. The appointment must fit the doctor's schedule and extra resources such as an x-ray beforehand or

transportation. When a patient cancels last minute, the appointment is often too specialized to that patient that it is difficult to fit other patients need, or the new patient needs completely different resources. Often the appointment cannot go to the next person waiting for the spot. This makes it almost impossible to fill up the appointment schedule.

One problem IO2 brings up is the capacity of the x-ray and how that affects their patients. Due to too low capacity and long wait times, it is often difficult to schedule the patient x-rays for the same day as their appointments. They get many complaints about this, especially for a patient who must travel long distances and stay overnight in Oslo due to it.

Cancellations are a significant problem to the flow, according to IO3. This is because patients often need to use the specialized treatment rooms, and even if they only need the generic room, these need the right equipment for the appointment. To be able to account for all the cancellation, they must double book some of their appointments. It is a calculated risk they have to take, and usually, it sorts itself out.

Because of the high level of specialization at the hospital, it is challenging to share personnel and resources. It would be unreasonable to place an orthopedic nurse in an Ear, Nose, and Throat room and expect her to handle the equipment there. The same goes for the rooms. The ear rooms need benches for the patients to lie on to be examined. Most of the generic treatment rooms of the other departments only have examination chairs and can therefore not be used by the ear department. IO3 think there is not as much sharing as it optimally could be.

Resource control and management is also a significant problem covering doctors, nurses, other staff, and rooms. They often have one of the resources but lack another. IO3 sees this as a bottleneck. An example from the ear department is having a doctor but missing an audiologist leading to them not being able to fill up the outpatient clinic. Some sections do not have enough equipment to have patients get the same treatment in a row. The specialized equipment needs to be cleaned between patients so that two such patients cannot be scheduled after one another.

The most significant flow bottleneck for IO4 is the doctors. The doctors have different tasks at the hospital so that in a week they have to offer different services. One day they might be in the operating theaters, one day at an outpatient clinic, and one day for teaching students in their discipline. It is on the days that they are in the outpatient clinic that IO4 needs to give service regarding test resources. The problem comes when the other tasks

infiltrate the outpatient service task. Such as when a problem arises in the operating theaters, and the doctor must run to assist. When the doctors have to change their schedule to to other tasks the problem occurs. Thus, usually, when there are bottlenecks to the flow, it is when the doctors have multiple functions and not just the outpatient clinic.

5.2 Results of semi-structured interviews

5.2.1 Understanding the performance demands

IO1

The eye department has concrete goals, particularly related to the previously mentioned AMD treatment. They increased their capacity in 2018 and continue to have specific goals on the capacity increase. IO1 sees the capacity increase as a patient flow specific goal. The other departments and sections, however, do not have specific patient flow goals. They have budgets and planned numbers, but IO1 says they do not say anything about their patient flow.

IO1 talks about how they are working on their being the right patient at the outpatient clinics, and that they are there at the right time. At the outpatient clinic, the patients are either on their way through their patient journey, or they are completing treatment. If the patient is finishing the treatment, being there at the correct time is not as important. However, for those patients that are going forward on their patient journey, i.e., On a surgical patient journey, then it is essential that the outpatient consultation comes at the right time. It cannot happen too long before the operation, or the patients' health status might have changed too much so that a new consultation is needed before one can operate. This is one of the most critical tasks for the outpatient clinics to accomplish.

When it comes to more measurable performance goals, capacity and the number of consultations is looked at the most, and the most important thing for the entire division to achieve when it comes to patient flow is the capacity, according to IO1.

IO2

The most crucial demand IO2 identifies for her section is to have full utilization of all consultation rooms and operating theaters. If they can accomplish this, she will be happy. She has three goals, for all the treatment rooms to be filled every day, for patients to have no wait time, and that patient

should arrive at the right time, both when it comes to the daily schedule and at the correct time according to their patient journey.

IO3

IO3 have many goals and demands on how her units handle the Ear section's patient flow. Their main goal is to fill up the appointments and to make sure that all patients get an appointment within their time limit. They have several demands from the Norwegian Ministry of Health and Care Services related to this task. They are:

- Every patient not given a new appointment should have a tentative date. That means that when a patient gets told that they should return in 4 weeks, even if they are not given a specific appointment, they should get a tentative appointment day that is exactly four weeks later. It is a requirement that this is an actual date, and they get measured on how many receive this date.

- They are measured in the number of patients that are still in the system, but without appointments. These limbo patients have neither completed treatment nor have been placed on a waiting list for a new appointment. It is a patient right to be on a waiting list if they have not finished their treatment, so this number should be as close to zero as possible.

- There is a limit to how long a patient should wait. This correlates to the patient journey, and when the doctors determine the next consultation or continuation of treatment should be. It is usually placed within three months since the last appointment.

- There is a time limit from when a referral is received to when a letter is sent to the patients wither with an appointment, if the appointment is within the next three months, or with the week they can expect to get an appointment. This time limit is ten days. So even if the evaluation is that the patient will not need an appointment before in a year, they will get the week exactly one year ahead as a tentative appointment time.

- All patients should get a new appointment with them when they leave the hospital if they have not finished their treatment. They should know when their next appointment is when they leave. The ones who need an appointment within three months must have an appointment

> in hand before they leave. This is measured by the Ministry, and are not the results IO3 thinks are their best.

They also work on correctly registering patients. This is especially important for the different dates for the rights. These dates need to be registered correctly and need to be updated when a right is achieved.

The most important thing for IO3 to accomplish when it comes to patient flow is to give the patients appointments at the right time.

IO4

IO4's unit does not have any production targets, and therefore, no specific patient flow goals. They have no control over who or how many patients they accept. It is the doctors that receive the referrals and who evaluate which patients get appointments. They only get the list of the patients they are going to treat.

Her unit mainly has quality goals. Once a year, the unit has a meeting where they decide on the next year's goals. Right now, the goals are to have a work environment characterized by openness and respect, to have a good learning environment, and to have a safe and pleasant treatment of patients. These goals are non-measurable.

It is IO4s goal to have the best possible utilization of her room and staff resources, she collaborates with IO3 to do this. IO4 need to be able to meet the demands of the doctors. Her responsibility is to make sure that they always have enough resources to be able to handle all the patients that come to the ear section.

5.2.2 Understanding the current system

IO1

IO1 has created several large spreadsheets containing data on the division. The one he uses most is a combination of information gathered from DIPS and the National Population Register of Norway. However, he also uses a management information system, which is a little easier to use. It contains a scorecard with performance KPIs for the division. The scorecard is still under development and currently only shows inpatient service numbers. The plan is to extend the scorecard with KPIs for the outpatient services as well, but what data to show had not yet been settled upon. It will also depend on the available data. The intention is that all leaders will get access to

the system so that they can stay informed about the performance of their operations.

The reporting happens at the discipline level, that is to say, the doctor section. This means that staff outside the doctor section does not have access, despite having managerial positions. So only discipline leaders, or doctor, have access, while managerial leaders like IO2, IO3, and IO4 does not. They can, therefore, not follow up on their clinic activity in the system. IO1 dislikes this and says the managerial leaders have just as much to say about the daily operations as he oversees many resources.

There are reports for the outpatient clinics. All managerial leaders can take these out, both on the clinic and the different clinic responsible. However, IO1 says these do not say much about the flow and more about the number of patients. It does look a little at capacity though, which can be seen as a flow indicator, according to IO1.

IO1 thinks that the managerial information tools are quite useful. The reports are updated once every day, and then they can be connected to other data to get a more holistic view. This can be used for planning and control. The reason he supplements them with his spreadsheets is so that he can connect the data to more sensitive private information that can still be important. This is data such as the Norwegian social security id. This makes it possible to see how many consultations a patient has had. He gives an example of when this can be of use. If a patient has not should for 21 consecutive appointments, this can be of interest. The reason might be that the patients are too ill to get to the hospital; the patient should be there but is too ill to come. Knowing this, it would be less of a gamble to set up an appointment parallel to this patient so that the patient's appointment time will not go to waste when there is a 99% reliability that the patient will not come.

IO1 says there are many available parameters for patient flow in the DIPS data. However, there is private data that should not be in a management system. What he wants is the typical numbers, such as the number of consultations, wait time, epicrisis time. Currently, the only way to get indicators of the patient flow performance is to enter the large spreadsheets and manually extract the information. They have a lot of information. However, most of the information is medical, not that much is organizational. Right now, he uses the parameters waiting time before the hospital and wait time at the hospital, number of consultations, and epicrisis time.

When asked about using cost indicators, IO1 replies that no, those are not used much. At least not on outpatient flow. They know reasonably well

how the clinics are covered. About 50% should be covered by the cost. It will vary some by the needs of the consultation. If it requires nurses or just a doctor or if it is not a doctor consultation at all. The cost of medical equipment can be omitted; it is so small. Thus, the cost is often somewhat similar. There are costs connected to staff, and there are some connected to equipment, but it varies very little. So, the cost of the outpatient clinics is more connected to consultation length and resource utilization. Moreover, it is more interesting to look at those indications than to look at just a number connected to cost. So IO1 would instead look at the indications leading to cost than to look at the only the cost.

Whether or not the patient has received a timely consultation before the operation is not measured for the outpatient services, but it is measured for surgery. When an operation is canceled there can be added a cancellation reason to the cancellation. One of the reasons can be "medical indication changed", which shows that changes to the patients' health status result in cancellation of the operation. Usually, changes have happened since the last outpatient consultation, which could have been revealed if the consultation had been closer to the operation and at a more proper time.

What he thinks there is too little focus on when it comes to outpatient services, and here he adds that they might be better at it, but it is difficult to say for it is latent in how they work, is the flow of referrals. He thinks they should look at the number of new referrals every year against how many patients need checkups to look at how much time the different examinations take. Looking at this will give a total of the outpatient clinic time needing to be filled. So, starting with the need, the demand, instead of the supply. He thinks they look at it from the wrong end of the stick.

They also need a room tool that can plan and mage the room resources and be connected to DIPS for the patient and staff resources and against Outlook. Just like they are doing in the efficiency improvement project at the Hospital in Østfold. The Hospital in Østfold has a room system. He thinks they have connected it to the other systems as well. They have just completed an effectiveness improvement project on their outpatient services, and the number one thing they wanted to accomplish was to connect their room system with their patient system and with outlook. In doing this, the doctors outpatient time will be in the calendar. IO1 says that this will lead to pretty good integration. Moreover, this gives the ability to see the room utilization. The Hospital in Østfold is doing a pilot project on it now.

IO2

IO2 says there is no system for performance measurement. They have numbers and data. However, it is not located in its own system. Much can be collected from the LIS reports. They have also worked with looking at the increase in activity for the different disciplines. Numbers are reported upwards in the hierarchy and are gone through on triannual meetings with the director. However, there are only numbers, and IO2 does not think this gives a holistic picture of the situation. Numbers are manually collected from the LIS reports, where they collect what they want to view. There are a lot of decent reports, according to IO2, that are new. She thinks there has been a nice change lately of available information

The LIS system and reports were introduced in 2013, so they are still, in hospital terms, new. When the system was developed, it was taken into consideration that some patient flow data could be extracted from them, such as the number of patients. The main thing they look at is the utilization of the rooms and the increase in the number of consultations, though they only have the number for the consultations.

All in all, today's system work pretty well, according to IO2. It is possible to extract numbers that give reasonable indications for the operational aspect. However, the numbers do not say if it is the correct operations. It is a good patient administrative tool, but it is not a good tool for the doctors. It heavily relies on precision when in use. It is very weak, according to IO2, to human errors, with many wrong registrations of patient and circumstances.

What they want to focus on now is if they have the correct patients at the outpatient clinic. They want to investigate if they have too many patients coming in for consultations and checkups as opposed to how many new patients they receive. Is it possible to complete treatment earlier? Moreover, what are the actual medical needs of the patients. IO2 says not many doctors want to focus on this. To start this work, IO2 would like to start looking at the number of patients one can get out of the system. The parameter completed treatment is one she would like to see. However, this might not be used much. It should be shown in relation to the number of new referrals. However, IO2 says nobody looks at this. Io2 does not look at the numbers for how many new patients and how many patients who have finished treatment because that is not her responsibility. Her responsibility is that the outpatient clinic is filled. It is the disciplines them self who looks at that sort of stuff.

It is a complex coordination in regards to the patients. Patients are not a comparable entity, and the needs vary significantly from patient to patient. A bed is not a bed, and a patient is not a patient. Since the product is

a patient, and there are individual considerations that need to be taken, it makes it difficult to measure and difficult to ascertain a proper system. When people say, "When it is this easy to order an appointment for a car at an auto repair shop, why isn't it as easy to do so for patients at a hospital?". However, a person is not a car. Everything is different.

IO3

The performance can be measured in LIS. It is those number that IO3 and the other coordinators need to relate to, even though they sometimes deviate from the number from DIPS. So, they work in DIPS, but they have to look it up in LIS how they are doing. They cannot report directly from DIPS. This is because DIPS contain personal data, so the information there needs to go through anonymization before it can be shown. Therefore, there is a slight margin of error.

IO3 reports to the department leader of the ear department. She reports on how many patients they have got and how many appointments there are, and how has canceled, who has not shown up to their appointments, or how many have not shown up to their appointments. They look at the same things as their performance demands when it comes to the patient flow.

There are two changes she wants. The first is a system that can separate the different cancellation in the outpatient clinic. She wants to be able to separate on why the appointment was canceled and when it was canceled. That way, she can open the program and see the reasons, and whether there is something they can do to fix the problem. Did the letter come too late or did the patient not receive it at all? That patients cancel and therefore, they not being able to fill up the clinic is a significant problem. So, she is very interested in being able to look more closely to see if there can be done something to solve the problem, and to see why people cancel.

The second is to make an electronic booking system for the rooms. The same way this works in many modern office buildings. This would make it easier to see which rooms were booked when and by whom. IO2 thinks this could be a significant improvement for utilization as well.

IO4

IO4 does not work with performance measurement. She only controls the resources. In her opinion, she does not influence the patient flow performance. Some days she has to reorganize the audiologists schedules to fill up their work schedules, while other days she lacks available resources. She would love to have a smoother daily operation than she has now.

The only performance reporting she does is to fill out the DIPS. All the audiologists are in DIPS as resources. There is an uneven balance between the supply and demand that she cannot control. According to IO4, she has no available numbers for consultation time, wait time both before or at the hospital, the waiting queue, or for the length of stay.

IO4 thinks it is very valuable to be able to measure the patient flow and to have access to KPI data. One of her problems currently is that she cannot look at her unit's operations. It is too closely linked to the section's outpatient clinic at a whole and the doctors. It is the doctors and their activity that triggers the DRG codes, so it is registered to the clinic and not to her unit. This way, she cannot get numbers for her unit alone but must look at the entire clinic.

IO4 was recently given access to LIS. She was interviewed a month after IO1, who talked about giving this access. What is new now is that they can enter the system and read about activity and resources. There is a report menu, and there they can choose the option for activity and resources. However, so far, this information is only available for the inpatient wards. There are plans for expanding this to the staffing of the outpatient clinics. When this is available, she will be able to go in and see how the activity is in relation to the staffing.

The idea is for unit leaders to be able to enter the system and keep update on the activity of their unit, to be better able to make decisions to improve it. An example given by IO4 is to be able to see that there are more patients on Fridays than on Tuesdays because they have a more substantial capacity on Fridays than on Tuesdays. Activity, which is an expression they use a lot, means the number of consultations through a day.

5.2.3 Developing performance indicators

IO1

According to IO1, the best indications for patient flow performance is capacity, wait time, and room utilization. He also mentioned how they did not look enough at the referral flow and connecting the patient journeys to the resource demand for the flow.

IO1 would like to have available data on room utilization. There is a lot of dispute about the surface area of the division and who should use it. Having measures for who uses or do not use their rooms would have helped, says IO1. Right now, it is more of an educated guess, and it is easier for the lower, more operational managers to get a feel for. He thinks it is a great

pity they do not currently have a system for this. A system that can both show the use of the room, and be used for planning how the rooms are to be used. It is currently possible to do it in the DIPS-system, but it is only possible to have the doctor as a resource or the room. Moreover, it is more important to be able to see the doctors in relation to the patients, rather than the rooms.

They have a field in DIPS that registers if the patient has waited for more than an hour. There is a law that says if the patient must wait for more than an hour, then the patient's charge is cut, and they get the appointment for free. There are not many patients that acquire this. IO1 says that it can work as an indicator for patient flow, but says it is a bit extreme. Moreover, it does not pick up on the patients that have to wait for 50 minutes, or 59 minutes. Also, there is a margin of error, so not all patients who wait an hour are registered. It must be used with care. However, for the time being, it is the only tangible indicator for patient wait time at the hospital.

An indicator that might be good is to see the number of patients that have finished treatment against the number of new referrals.

IO2

IO2 thinks the most valuable indicator for operations is room utilization. She also mentions the rate of new referrals and patients completing treatment.

When asked to comment on the list of PIs from existing literature, these were her comments:

WTB Not very relevant to her, she has more of a focus on the daily operations at the hospital

WTH Yes, they try to keep the wait time as short as possible

LOS Yes, they look at this in relation to the wait time

T They have a target of between 12 and 14 patients per day

ST They use this, but not necessarily as an indicator for flow. The average time they try to keep is 20 min.

RU Yes, this is very interesting. Right now, resource utilization is about 85%

A live indicator for wait time would lead to more stress. At the outpatient clinic, the patients must leave before the staff can leave. Therefore, IO2 thinks it will lead to more stress for the staff to have a live indicator of the waiting times. They have their work schedule for the day and can look at this to see whether they are behind. Also, it is difficult for them to make changes that can affect the flow.

They increased their capacity by 40% from 2009 to 2. This was done by increasing the room utilization and decreasing the consultation time. In this process, the PIs capacity, room utilization, and consultation time were used.

IO3

The patients in limbo are perhaps the best indicator for flow, according to IO3. Moreover, she adds that they must make sure they do not breach any of the time limits is very useful. It has led to the patients getting appointments. She tells about how, a couple of years ago, there were over 100 time limit breaches per month. Now they have zero. It was a big clean up, and they gained control of the waiting list as a result. So, it is a very useful indicator that has given visible results. She has enjoyed being part of that work, so it is a useful indicator.

IO3 thinks several indicators are useful. Maybe the one about the long waiting patients is the least useful. Since they often have a medical reason. So, there is a need for a connection to other data to be able to get useful information about it. So, it is a bit unnecessary to use time and resources on it. Better to focus on giving patients an appointment within three months. To have that as a focus would have been better.

She also sees the value of the PIs wait time before the hospital, wait time at the hospital, and resource utilization.

IO4

IO4 repeats that she uses no system for performance measurement of patient flow. When asked to comment on the list of PIs from existing literature, these were her comments for the ones she though useful:

WTB Yes, it is interesting to look at, especially for pediatric patients.

WTH Yes, absolutely fascinating to look at how long the patients have to wait. How long do they have to wait for the doctors when they have finished with an audiologist.

LOS Yes, when seen in connection to the WTH

DTE Yes, she thinks this could be interesting. I.e., When looking at time from audiologist until doctor. So perhaps the same as for WTH

T Same as the activity, so she already views this one

WQ Not interesting for the at hospital queue, here it is more interesting to look at wait as time. However, for the before hospital wait, this would be an interesting indicator. Both to be able to see how many are waiting and for how long they have waited.

ST Yes, to be able to see who long the different treatments take. So that they can see if they are overshooting or undershooting

RU She uses the utilization of the audiologist that she can find through DIPS a lot.

AB No. It presumes that a resource is occupied while the patient waits for a new resource. For the outpatient clinics the patients use the waiting rooms while waiting for new resources.

R Not as interesting for them. Most of the hearing unit's patients are lifetime patients.

5.2.4 Designing reporting and presentation

IO1

The ideal system, according to IO1, will be to develop the scorecard with the right and useful indicators. Moreover, to develop a room system and connect that to the other systems. To get the room utilization for each section, that is IO1's dream. Moreover, also, to be able to combine both of the hospital's managerial dimensions, disciplines, and area.

It is not valuable for every doctor. This is managerial information, both for linear discipline leaders and other linear medical staff leaders. He is opposed to cramming this sort of information into all staff and thinks it best if it only for the managerial staff.

IO2

IO2 says the most important indicators are the ones giving long-term feedback. This way, they could make changes based on performance. IO2 does

not think these changes can be made on a daily operational bases, but rather on a long-term planning and control basis. In the same line, she thinks the system should be for management only, not for floor staff.

IO3

IO3 thinks it should be useful for doctors, nurses, and other medical staff because they often do not see their role in the big picture. They have more of a patient by patient, day by day view. Moreover, maybe they do not see how their actions can have consequences forwards, backward, or sideways in the functional line. She does not understand that they are not more interested in the flow of the clinic.

It is also her personal experience that both nurses and doctors take a larger responsibility and feel more ownership towards the systems and the reports. She thinks everyone should get access to the indicators, at least a few chosen KPIs.

IO4

Everyone at the hospital with LIS access can gain access to the LIS reports regarding staffing and activity. IO4 think this should be limited to only personnel inside the functional line. She wants the reports only to be available to her leaders directly above her, not to peers. This is because she thinks that the patient group differs too much so that it can be difficult for others to understand the demand of that unit or ward. I.e., if she is a nurse running a ward with a certain number of inpatients and a certain number of staff. Moreover, there is a neighboring ward with the same number of inpatients, but with three fewer staff. She worries that the leader of the post with less staff may see this in the system and will need explaining why she has less staff because to her, that might seem unfair. She thinks this system might create unrest in the organization by staff reading report without the necessary understanding behind the decisions. She thinks managers might have to use a lot of time and resources to explain the imagined imbalance.

However, she does think that everyone in the functional line should be able to see the numbers. She says it is only positive. She thinks the audiologist could benefit from logging in to the system and following up on the clinic. She thinks it will make them take more ownership of their workday.

The performance indicator of outpatient patient flow

In this chapter, indicators from existing literature are discussed to ensure they fit an outpatient performance measurement system. First, the performance indicators from the case study are presented. Then performance indicators from the literature study are presented and discussed in relation to the case study. Lastly, the set of PIs are given.

6.1 The performance indicator found in the case study

This section sums up the performance indicators found in the case study in Chapter 5.2.1, 5.2.2, and 5.2.3.

Cancellation measures - Patients canceling was seen as a bottleneck for patient flow by most of the IOs. Performance measures relating to this should, therefore, be used as an indicator.

Room utilization - Though this measure can be seen as a measure for the resource utilization indicator, it was mentioned by all four IOs and should, therefore, be a performance indicator.

Treatment status - A clinical flow measure regarding the status of the patient journey. Includes measures such as new referrals, number of control and check-up consultations, and the number of patients who have finished treatment.

Wait list - The measures for the clinical patient flow used by IO3 for the department wait list performance. Includes measures such as time limit

breaches, the number of patients in appointment limbo, and average wait time for patients.

6.2 The performance indicators found in the literature study

This section sums up the performance indicators found in the literature study. The indicators can be seen in Figure 4.3.2, while Figure 4.1.2 and Figure 4.3.1 shows the articles where the PIs were used.

Boarding time - Cannot be used for outpatient clinics. Is defined as the time from the decision to admit a patient to the hospital from the ED to the patient is moved from the ED. It is, therefore, not connected to outpatient flow.

Discharge and admittance - Cannot be used for outpatient clinics. Requires patients to be admitted to the hospital, which is the definition of an inpatient patient, not an outpatient one.

Door-to-event time - Can be used by outpatient clinics as a supplement to the Length of stay and Wait time at the hospital measures.

Length of stay - An important indicator mentioned in both case study and literature study. Can be used.

Occupancy - Is usually defined as the occupancy of beds. The indicator will therefore not be included in the list. Similar measures can be seen in the Throughput indicator.

Readmission - Can be used for some outpatient clinics, but not all. It is essential to separate between lifetime patients, i.e., in the hearing unit or eye department, and patients who undergo treatment and is done, i.e., patients found in the day surgery department.

Resource utilization -An important indicator mentioned in both case study and literature study. Can be used. However, due to room utilization being of such importance in the case study, this measure will be split in two - one for the room utilization, and one for the other resources.

Service time - Mentioned often in the case study in relation to consultation time. Can be used.

Staff overtime - Mentioned in the case study by IO2 as one of the parameters on her reports. Can be used.

Throughput - In the case study, measures such as capacity and activity were mentioned as important performance indicators. These can be categorized as Throughput measures.

Wait time before the hospital - Has been incorporated into the waiting list indicator.

Wait time at the hospital - Was one of the most mentioned indicators in both the case study and literature study. Can, therefore, be used.

Waiting queue - The only time this indicator was mentioned in the case, was in relation to other indicators. It will, therefore, be incorporated into the indicators for Wait list and Wait time at the hospital.

6.3 List of performance indicators

The final list of PIs for performance measurement of outpatient clinic patient flow can be seen in Table 6.3.1.

Table 6.3.1: The performance indicators for performance measurement of outpatient clinic patient flow

PI group	Definition	How to measure	Abbreviation
Cancellations	Measures relating to the cancellations of consultations. Both by the hospital and by patient	Number of canceled patients	C
Door-to-event time	The time from a patient is registered or admitted until a certain event has taken place. Can also be called Door-to-bed, door-to-doctor, door-to-surgery, door-to-order.	Minutes, hours	DTE
Length of stay	The length of stay for a patient at a ward, a department, or the entire hospital stay. Measured from time of admittance or registration, until discharged. Can also be called ALOS (average length of stay), turnaround time, patient lead-time, door-to-discharge.	Hours, days	LOS
Readmission	Patients that return to the hospital for the same illness in a certain time frame	Percentage of patients discharged, number of patients	R

PI group	Definition	How to measure	Abbreviation
Resource utilization	Utilization levels of hospital resources such as physicians, nurses, beds, and equipment.	% out of full utilization	RU
Room utilization	Utilization degree of the different treatment rooms at hospitals	out of full utilization	ROU
Service time	The time it takes to complete one service. Can also be measured in how many times one service can be done in a time frame. Can also be called service rate, cycle time.	Minutes, hours, times per hour	ST
Staff overtime	Time a staff member must work beyond the set work hours	Minutes, hours	SO
Throughput	The patient throughput of a ward or department. The capacity of the outpatient clinic.	Patients per hour, number of patients	T
Treatment status	Measures regarding the where the patients are in their patient journeys	Number of patients with finished treatment, number of new referrals	TS
Wait list	Measures relating to the patient waiting list.	Average wait time for new consultations, number of patients with time limit breaches	WT
Wait time at hospital	Patient wait time is the time a patient waits for hospital resources such as a nurse, a physician, or a bed. Is usually measured as an average for all patients within a group and a time frame.	Minutes, hours	WTH

A framework for a preformance measurement system for outpatient patient flow

In this Chapter, the performance measurement framework is developed. First, the preferred set of PIs is evaluated using frameworks and criteria from performance measurement theory. Then the different PMS frameworks are discussed to choose the basis of the new framework. Lastly, the framework is discussed and presented.

7.1 Evaluation of the PI set

In Chapter 3, five different frameworks were presented in Figure 3.5.1 to use for ensuring that the correct set of PIs was chosen and that the set represented a holistic view. The five are presented below, accompanied by a discussion on whether the set fulfilled the criteria.

Slack (2010)'s five performance objectives and typical measures

Slack (2010) presented five performance objectives that need to be fulfilled, cost, dependability, flexibility, quality, and speed, and gave examples of typical measures in Figure 3.3.1. Cost looks at the cost connected to producing a product or delivering a service. IO1 said that cost related indicators were not used, due to the parameters leading to the cost being of more interest to look at. However, Slack (2010) mentions the utilization of resources as a typical measure, and this is covered by the Room utilization and Resource utilization PIs.

Dependability relates to the dependability of the service delivered by the organization. These measured can be covered by the Wait list PI with a

similar measure being the percentage of orders delivered late to time limit breaches.

Flexibility relates to the responsiveness of the organization. It can be covered by the Throughput PI, with similar measures being average capacity/maximum capacity.

Quality relates to the quality of the outcome of the service. It can be covered by the Readmission PI, with similar measures being number of defects per unit.

Speed relates to the delivery speed of the service. It can be covered by the Wait list, Service time, Throughput, and Wait time at the hospital PIs. Similar measures are: cycle to consultation time.

It can, therefore, be concluded that all the five performance objectives have indicators to show if an action fulfills said objective. Having measures covering all five objectives implies having a holistic system that shows no apparent holes.

Neely et al. (1995)'s four performance measurement categories

Neely et al. (1995)'s four performance measurement categories are similar to Slack (2010)'s, except that it has combined the objectives of speed and dependability into one category, time. Since the last section showed how the set of PIs covers all the objectives of Slack (2010), it can be presumed that the same holds for the categories of Neely et al. (1995).

Fitzgerald et al. (1991)'s two types of performance measures

Fitzgerald et al. (1991) suggests two types of performance measures. Result measures that relate to the competitiveness and financial performance, and determinant measures for how these results can be accomplished that relates to quality, flexibility, resource utilization, and innovation. This section has already shown how the set of PIs covers the determinant measures. The result measures can be covered by the Service time and Wait list PIs.

Donabedian (1988)'s three indicator categories

Donabedian (1988)'s three indicator categories are structure, process, and outcome indicators. The structure indicators give measures on the attributes of the setting in which care occurs. Usual measures can be the adequacy of facility and administrative structures. This category can be covered by the Resource utilization, Room utilization, and Wait list PIs.

The process category gives measures on what is done in giving and receiving care. Measures are usually centered around the physical examinations and

procedures. This category can be covered by the Door to event time, Length of say, Service time, Staff overtime, Throughput, and Wait time at hospital PIs.

Lastly, the outcome category gives measures on the effects of care on the health status of patients. Usual measures can be in terms of recovery, and restoration of function. It can be covered by the Readmission and Treatment status PIs.

Conclusion

In conclusion, the set of PIs fulfills the criteria set by all five frameworks. This implies that the set can form the basis of a holistic performance measurement system that shows no obvious holes in indicator coverage.

7.2 Discussion of frameworks for patient flow PMS

This section discusses how the different PMS frameworks fit to present the set of PIs for patient flow performance.

Kaplan and Norton (1992)'s balanced scorecard

De Pourcq et al. (2016) shows that using the balanced scorecard can be a good way for choosing performance measures for a health care service, however when the focus is only on patient flow the most important perspectives are the patient perspective and the internal business process perspective. In addition, the financial perspective becomes void as IO1 shows that cost measures are not preferred by an actual hospital. Therefore, the balanced scorecard of Kaplan and Norton (1992) will not be used when developing the PMS framework.

Martinez et al. (2018)'s role-specific PMS

The PMS of Martinez et al. (2018) utilizes three different leadership roles, to show which positions would get the most value out of the PIs. The case study showed that the different managerial positions had different opinions and needs when it came to the performance measurement system. It can, therefore, be concluded that using this differentiation would greatly benefit a real hospital with a similar hierarchical organizational structure. Martinez et al. (2018)'s framework idea will, therefore, be adapted for this PMS framework.

Villa et al. (2014)'s three level hospital view

Villa et al. (2014)'s framework adapts a three-level hospital view to analyze the performing of the cross-hospital patient flow. Though the view works

well for cross-functional patient flow, it is not as well adapted for focusing on only one subsystem. Though it would be interesting to see how the outpatient patient flow correlates to the patient pipelines and the overall hospital flow, this is not in the scope of this thesis, and the framework will not be adapted.

The Donabedian framework from Donabedian (1988)

Two of the PMS articles found in the literature study adapted versions of the Donabedian framework in developing their systems. Stefanini et al. (2018) uses the framework to measure the Emergency departments, ED, performance by analyzing the patient flow. He only focuses on the process indicators, and though this offers an interesting view of the ED performance, it does not give the holistic view that this thesis strives for.

The division of the performance measures seen in Khalifa and Zabani (2016) works in the same way as the division in the Donabedian framework. For Khalifa and Zabani (2016), the input measures are the same as the Donabedian structure measures, the throughput measures are the same as the process measures, and the output measures are the same as the outcome measures. Khalifa and Zabani (2016)'s PMS shows that using the Donabedian framework is a good way of dividing the performance indicators of a patient flow PMS and that it can be successfully used to create a holistic system.

Conclusion

To conclude the discussion of the different frameworks, this thesis will use the role-specific performance indicators from Martinez et al. (2018)'s framework to represent the findings from the case study on how the different managerial roles affected the outlook on performance measurement. To further structure the framework, the Donabedian frameworks three performance indicator categories, (Donabedian, 1988), will be used to categorize the performance indicators. The Donabedian framework was chosen due to the successful implementation of it shown in the PMSs of Khalifa and Zabani (2016) and Stefanini et al. (2018), and the health care specific angle.

7.3 Developing the framework

The measures have already been divided into three categories when the PI set was evaluated in Chapter 7.1.

When deciding on which managerial roles should be recommended the PIs the responses from the case study was taken into consideration. Martinez et al. (2018) used three levels of leadership. The unit leaders oversaw the different wards and operational units. The service leaders oversaw delivering the entire service, i.e., medicine, surgery, pediatrics. The institutional leaders in charge of the entire hospital. This thesis will look at the unit leaders, as the managerial staff of the units and sections, followed by the department leaders, and finally, the division administration and hospital director administration.

For the structure PIs, the following uses are recommended. Resource and room utilization were requested PIs from all IOs should be used by all three users. The Wait list PI is most valuable for the planning and control positions, and long term feedback. Here the role of wait list responsible is placed at the department level even though IO3 is a unit leader she is responsible for the entire departments wait list. The Pi should be used by the department leaders and the division and hospital administration.

For the process PIs, the following uses are recommended. The Door to event time PI is seen as an operational flow measure and should give value mostly to the unit leaders. The length of stay, Throughput, and Wait time at the hospital PIs are the most used PIs of general hospital patient flow performance and should, therefore, be used as general indicators for all levels. The Service time and Staff overtime PIs are essential for planning the daily operations at the outpatient clinics and should, therefore, be useful for the leader levels responsible for this.

For the outcome PIs, the following uses are recommended. Both the Readmission PI and the Treatment status PI are valuable for the planning and control positions, and long term feedback. These are also the positions requesting these PIs in the case study. Therefore, the Pi should be used by the department leaders and the division and hospital administration.

The final framework can be seen in Table 7.3.1.

Table 7.3.1: Performance measurement system framework for outpatient patient flow. Users; U, unit leaders; D, department leaders; H, division and hospital administration.

PI type	**KPIs**	**Role**		
Structure	Resource utilization	U	D	H
	Room utilization	U	D	H
	Wait list		D	H
Process	Door to event time	U		
	Length of stay	U	D	H
	Service time	U	D	
	Staff overtime	U	D	
	Throughput	U	D	H
	Wait time at the hospital	U	D	H
Outcome	Readmission		D	H
	Treatment status		D	H

Conclusion

This thesis uses a literature study and a case study to identify a list of PIs for patient flow performance measurement at outpatient clinics and to develop a framework for a performance measurement system for patient flow performance measurement at outpatient clinics.

The final set of PI included performance indicator from both the literature study and the case study and provided a holistic view of the patient flow performance. The framework used performance indicator categories and organizational roles to structure the PI set.

Even though the case study contributed to less degree than the performance measure theory and the result from the literature study to the development of the framework, it was still a significant contribution both to the hospital and to performance measurement of patient flow research to map a performance measurement system at a hospital. It was also important to gain empirical experience in order to develop a system that could work in a real hospital.

Limitations

There are several limitations connected to the case study interview approach. These include bias due to poorly articulated questions, response bias, inaccuracies due to poor recall, and reflexivity when the interviewee answers he or she thinks the researcher want to hear Yin (2009).

It should also be mentioned that one of the interview objects was a family relation to the author of this thesis, though every possible measure was adopted to hinder bias.

The literature study was limited by time constraints and the amount of work. Not all articles containing performance measures for patient flow

could be reviewed. It is, therefore, possible that relevant studies were overlooked when scoping the structured literature study.

Further research

This thesis recommends moving forward with testing, evaluation, and implementation of the framework. The framework should be presented to the case hospital for further interviews and reevaluations.

Furthermore, it would be of interest to see if the framework of the framework development process could be used for the other hospital subsystems.

Lastly, to establish a generalization of the framework, it should be tested and evaluated at other hospitals both in the Norwegian health care system and for other health care systems.

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Appendices

Appendix A

PATIENTS AT NORWEGIAN HOSPITALS

	Patients at general hospital, in total		Out-patients		Number of out-patient consultations	
	2012	2018	2012	2018	2012	2018
F00 Total						
Both sexes						
Years, total						
Number of patients or treatments in total	1 763 265	1 967 758	1 558 445	1 805 809	5 017 044	6 199 756

Figure A.0.1: Table from Statistics Norway on the number of patients at Norwegian hospitals from 2012 to 2018. Sourced from Statistics Norway

Appendix B

INTERVIEW GUIDE

Mapping of position and clinic:

- What is your position and what tasks does it entail?
- How many rooms, both specialization rooms and general rooms, are there?
- How many doctors and nurses are there?
- What are the opening hours of the clinic?
- What is the degree of utilization of the rooms?
- What is the average consultation time?
- How well are the rooms and the areas placed in relation to each other?

Understanding and mapping the clinics structures and processes:

- How is the clinics structured? Who is in charge of the clinic's performance, patient flow, etc.? Does the clinic cooperate with other clinics in a way that effects the daily operations of the clinic?
- How does the usual patient flow thorught the clinic looks? What stop and stations does it go through?
- What are the clinics main tasks?
- Are there problem areas in the flow, i.e. bottlenecks?

Developing performance demands for the clinic:

- What goals does the clinic try to achieve, are there any patient flow specific goals?
- What is most important for the clinic to achieve in regards to flow?

Understanding the current system:

- How is performance measured in the clinic?
- Are there multiple systems?
- How are they used and what are their function?
- I.e. What, how, whom, and when is performance reported?
- Does the system have performance indicators for patient flow?
- Which?
- How was the system developed? What was the thought process behind it?
- What works and what does not work in the current system?

Deciding how necessary data should be collected

- What parameters are available for you to measure patient flow?
- How are they measured, how often, and how are they made available?

Developing performance indicators:

- Out of the performance indicators in use now, which are valuable and which are not?
- What performance indicators for patient flow do you see as valuable for daily operations?
- Do you have any suggestions for good performance indicators for patient flow?

Design of report and presentation:

- How can/should one report and present the information for the system to be used and be useful for the clinic?
- Who should have access to what information?

Other:

List of performance indicators from literature study:

WTH Wait time in hospital

WTB Wait time before hospital

LOS Length of stay

DTE Door to event time

T Throughput

WQ Wait queue

ST Service time

RU Resource utilization

DA Discharge and admittance

AB Access block

C Capacity

R Readmission